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MEDICINE.—*Comings and goings of epidemics.*[1] GEORGE W. McCOY, M.D., National Institute of Health.

Although the study of disease as manifested in the individual patient is one of the most interesting vocations for those whose tastes run along such lines, of far greater interest, and obviously of greater importance, is the study of disease as it affects a group, or groups, of people. The group may be small or it may be so large as to include all or most of the race.

Everyone knows that the manifestations of the same disease differ with individuals and an acquaintance with this variance is often the secret in making correct diagnoses. In a similar manner, outbreaks of disease at different times and in different places show variations, the recognition of which leads to accurate epidemiological diagnoses. I shall endeavor to illustrate some of the problems in epidemic diseases that have been solved and to consider others that remain to be solved. By observation and study of disease as manifested in a population it is often possible to learn the factors governing the prevalence of the particular disease and, this learned, to take effective measures of prevention or suppression.

Epidemic is defined as "common to, or affecting at the same time, a large number in a community." Generally, the term is used in reference to communicable diseases but we have it applied to such miscellaneous non-medical occurrences as traffic accidents and bank failures.

In this presentation, I have had occasion to consult several standard works, particularly the *Bible*, Hirsch's *Handbook of Geographic and Historical Pathology*, Delmage's work entitled *The Nation's Health*, and, finally, Vaughan's *Epidemiology and Public Health*. The latter, an exceedingly valuable work and especially useful to anyone interested in the history of epidemics, was the last important literary contribution of the late Dr. Victor C. Vaughan, a very distinguished physician, long a resident of Washington and a member of the Cosmos

[1] Address of the retiring president of the Washington Academy of Sciences delivered January 16, 1936. Received January 17, 1936.

Club. I have drawn freely on all of these works and here make acknowledgment of these sources of information.

Delmage (p. 65) states that the principal diseases prevalent during the middle ages were "famine pestilences, plague, leprosy, ergotism, scurvy, dancing mania, syphilis, malaria and various skin diseases." Omitting skin diseases as being too indefinite for comparison, only two of the remaining diseases he mentions are of great importance today, malaria and syphilis. I am not informed as to the exact nature of the "dancing mania" of those days but I have a suspicion that it is still on the decline after a recrudescence of the post war period and the era of national prohibition. Delmage makes no mention of any of the diseases we recognize as heading the list of causes of death at the present time—cancer, heart disease, pneumonia, and tuberculosis—though doubtless they were just as prevalent then as now, but on account of the greater prevalence of other diseases did not earn for themselves a prominent place as major scourges.

Epidemics may be due to unusual and rarely occurring combinations of circumstances. For instance, a consignment of psittacine birds is shipped from an aviary in California to an eastern department store; the birds are displayed and admired; some are purchased and taken home; then, perhaps ten days later, a few of the employees of the store, admirers, or purchasers of the birds become ill with a peculiar type of pneumonia that puzzles attending physicians. These cases are scattered in various parts of the community. At first sight there is no suspicion as to relationship between cases. Then, quite possibly by chance, it develops that the illness began a week or ten days after the arrival of the birds in the store or after bringing the new bird into the home—the bird, or birds, perhaps sickening in the meantime. The solution of the epidemic from that time forward becomes a routine matter for the health department staff. Perhaps many similar outbreaks of this type come and go without being recognized.

An excellent example of how a disease ordinarily not known to prevail in epidemic form may, by some peculiar combination of circumstances, become epidemic is to be found in the outbreak of amebic dysentery centering in Chicago in the summer and fall of 1933. Here was a disease which the very elect among special students in the field had said never was, and indeed never could be, epidemic; and we all subscribed to the dictum. Then came one of the unforeseen, and humanly speaking unforeseeable, tragedies in public health. Through peculiar circumstances there occurred an opportunity for

the drinking water supplies of two hotels in Chicago to become infected with the protozoal organism causing one of the types of dysentery. There resulted about 1200 reported cases, scattered all over the country, and of these about 100 died. There is good reason to believe that the total number of cases and deaths exceeded this considerably but it was not practicable to secure full reporting. It took quite a while even for those of the medical profession who were especially interested in the problem to admit that there could be, and was, an epidemic of this type of disease. In addition to being the first widespread epidemic of this disease in a civil population it made us all conscious of the possibility of impure water being involved in the causation of the disease as it ordinarily occurs.

To illustrate that our concept of epidemics need not be limited to communicable diseases let me briefly discuss scurvy. We first hear of it in the 13th century in connection with the Crusaders, although doubtless it existed long before that time. According to Vaughan, Joinville (1260, p. 37) wrote: "The barbers were forced to cut away large pieces of flesh from the gums, to enable their patient to eat. It was pitiful to hear the cries and groans of those on whom this operation was performing; they seemed like the cries of women in labor." The disease was a special scourge of navigators and explorers. Scarcely an expedition but suffered cruelly from the ravages of what we now know to be an easily preventable disease. Thus, Vasco da Gama's voyage around the Cape of Good Hope, in 1497, resulted in the loss of about two-thirds of the men, mostly from scurvy. Magellan's crews on the voyage around the world, begun in 1519, the first in history, were harrassed by the disease. Cartier's expedition to Canada, 1535, has yielded us a clinical description of such noteworthy fidelity that I forbear reading it to you so gruesome are the details. Apparently the disease was previously unknown to Cartier and his medical staff but they found that the juice of the bark and leaves of a certain spruce was an effective remedy, a clear hint as to the relation to diet now so well established. As early as 1564, orange juice was prescribed in the treatment of scurvy, the first mention of citrus fruits in connection with the disease.

Lind, a British naval surgeon, whose view was about 150 years in advance of his time, carried out (about 1750) what we would now call a feeding experiment to determine the diet most effective in the treatment of scurvy, but (and it shows that bureaucracy was pretty much the same then as now) it took another 50 years for the British Admiralty to take the necessary administrative action to profit by

his findings. Lind added nothing essential to what had been known for 200 years, but he was a true scientist and furnished proof of what up to that time had been only belief.

Captain Cook, in his voyage around the world from 1772–1775, lost not a man. He carried an ample supply of sauerkraut. Take your choice, sauerkraut or scurvy! The sailor of that day was not fastidious and had no difficulty in making the choice. To show you that I have a little historical data of my own, and lest someone criticize the accuracy of my statement about Cook's voyage, I want to say that I know quite well that on a later voyage, 1779, Captain Cook was killed by the natives of Hawaii. I have visited the place where he is said to have been killed, and, in order to show still further my first hand information on this subject, let me say that I have visited the monument erected to Captain Cook's memory by the British government, and am aware of the fact that every few years a British cruiser is sent to Hawaii to "police up" the surroundings of the monument.

Yet in spite of these experiences, several years after Captain Cook's voyage, a 10 weeks' cruise of the British fleet in the Bay of Biscay resulted in 2400 cases of scurvy—so slow is official authority to recognize and adopt new measures. This disease has played an important role in land military operations as well as at sea, prolonged sieges always bringing it to the fore among the besieged and besiegers, always, of course, due to the same essential cause, deficiency in diet. This disease, which at one time was so prevalent, affecting civil as well as naval and military populations, has now become practically unknown in the civilized world save in what we might call the rudimentary form that occurs among infants.

"Sweating sickness" is the only disease entity on record that seems to have vanished completely centuries ago. According to Delmage, this disease prevailed in England for a period of about 65 years in the latter part of the 15th and the early part of the 16th centuries. According to the same author, "it was characterized by a very sudden onset, acute symptoms, and profuse sweating" or, as a contemporary observer puts it, by a "grete swetyng and stynking and a contynual thirst with a grete hete and headache." It seems to have sought out by preference the highly placed. Thus, we find mentioned as victims two lords mayor and four aldermen of London; also Wolsey, the Venetian ambassador, and Anne Boleyn. The King, Henry VIII, appears to have escaped the affliction by keeping on the move. It sounds like the history of an infectious disease but against this is evidence that it produced no immunity as repeated attacks in the same individual

are referred to. This, of course, does not absolutely exclude the infectious nature. The disease invaded the Continent of Europe and is said to have broken up the Diet of Worms in 1521, perhaps fortunately for intellectual progress and the liberalization of the minds of men. Medical historians are not able to identify this epidemic visitation with any earlier or later outbreak of any sort.

Having given an example of a disease that has disappeared, let me now give you examples of new, or relatively new, diseases—though it is doubtful whether any disease is really new; often it is new only in the sense that it is newly recognized. We usually regard tularaemia as a new disease since not even the name was known more than a decade ago, but my colleague, Doctor Francis, who has contributed so much to the knowledge of the disease, has unearthed cases that occurred long before we had any scientific knowledge of the infection, which, as you know, usually is derived from dressing infected animals, nearly always rabbits. A friend with a much better knowledge of the Bible than I have calls my attention to the fact that among the ancient Hebrews the rabbit (coney) was forbidden as food, and argues that this prohibition could come only from a knowledge of a disease derived from the forbidden food (Leviticus, chapter 11, verse 5). The injunction in the 8th verse of the same chapter reads: "Of their flesh ye shall not eat and their carcasses shall ye not touch."

This disease, not communicable from person to person, would hardly have been recognized as epidemic before the days of bacteriology and for practical purposes may be regarded as a newcomer but it is recognized now in nearly every State in the Union and in several foreign countries.

For a century or more physicians in the Mediterranean area have recognized a disease of long duration and peculiar clinical characteristics which many years ago was found to be contracted usually by the drinking of goat's milk. So firmly established was the relation between the goat and the sick man that no one thought of Mediterranean fever, undulant fever, or Malta fever, as it was variously known, save in association with possible sources of infection among goats. In this country, the occasional case recognized was traceable to goats and the distribution was limited almost entirely to the southwestern part of the country where the goats were known to be infected. Then came the brilliant work of Miss Evans and others, who showed that undulant fever might be derived from cattle infected with contagious abortion. A new disease was created, or discovered, almost overnight. Cases began to be recognized nearly everywhere in the United States

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and in many other parts of the world. Whether the many cases now reported by physicians really represent a new disease in this country or whether similar cases have been with us a long time but have not been correctly diagnosed, can not be answered in a satisfactory manner. There would seem to be valid arguments for both views. For practical purposes, we may regard the infection derived from cattle as a new disease in this country, and indeed this holds good for the temperate parts of the world generally.

Among the epidemic diseases relatively new to the race, none is more interesting than the group affecting the nervous system. I shall discuss briefly two of these.

Cerebrospinal fever, perhaps more often called cerebrospinal, or epidemic, meningitis, appears to have been quite unknown until 1805, when it was reported in Switzerland. Within a few years it has been identified in many places in Europe and America. This is a disease of very pronounced manifestations in the sick individual and of marked peculiarities in its epidemic qualities. The great Osler thought that the keen medical minds of the 17th and 18th centuries would not have overlooked it, and said: "In cerebrospinal fever we may be witnessing the struggle of a new disease to win a place among the great epidemics of the world."

A year after the occurrence of the Geneva outbreak (the first reported) the disease was discovered, independently, in New England, and from that time down to the present most countries have had anywhere from a few scattered cases to disastrous epidemics. For a long time after the disease became established as an entity quite apart in origin from any other disease there was much questioning as to whether or not it was contagious. For one of the most convincing experiences in this connection let me quote from Vaughan:

> For many years Boudin stood almost alone not only among French observers, but among those in all parts of the world, in contending for the infectious nature of this disease. One of the most convincing instances cited by Boudin in his contention for the infectious nature of the disease is the experience of the 18th infantry (of the French army). Cerebrospinal meningitis had been epidemic among the civil population in the Department of Landes in the Lower Pyrenees adjacent to Spain for some years prior to 1836. This regiment was stationed at Bayonne in this part of France and was in part recruited from the population of this section. Cerebrospinal meningitis appeared in two garrisons in the Department of Landes, Bayonne and Dax, in which this regiment was quartered. The regiment moved first to Bordeaux and then to Rochefort, but the disease not only continued with the regiment, but spread to some slight extent outside the garrison, especially at Rochefort where the inmates of a prison became involved. This regiment was stationed at Bayonne in 1836. It left Rochefort at the end of

1838 and went to Versailles. In February, 1839, six men of the regiment, all occupying the same room, came down with cerebrospinal meningitis at intervals of a few days. At Versailles the disease extended to other regiments, but out of a total of 160 cases at that place 116 occurred in the Eighteenth, while the remainder were distributed through four other infantry regiments and three troops of cavalry. The Eighteenth regiment was subsequently transferred to Chartres and later distributed to Metz, Strasbourg, Nancy, Schlestadt, and Colmar, in all of which places cerebrospinal meningitis not only continued in the Eighteenth Infantry, but especially attacked the recruits to this regiment, and spread to other military organizations with which the Eighteenth came in contact and, in some places, to the civil population. There is some reason for believing, though the proof is not clear, that the disease was spread by troops from the Department of Landes towards the Mediterranean. From 1841 to 1849 nearly every garrison in France from Lille in the North to Marseilles in the South and from Brest on the Atlantic Coast to Strasbourg on the Rhine reported small epidemics of this disease. Not only was this true, but cerebrospinal meningitis was carried by French soldiers to Algerian garrisons.

Finally, in this group, comes epidemic encephalitis, the history of which is recent. I think there is much question as to the identity of various outbreaks of the encephalitis group of diseases. For practical purposes we may consider the outbreak in St. Louis in 1933 as a unique event in medical history. Coming apparently from nowhere, progressing for three months, and vanishing as mysteriously as it began, the disease could not be identified beyond doubt with any previously recognized clinical and epidemiological entity. It attacked about 1,000 people and took the lives of about one-fifth of that number. It was tentatively grouped, by those studying it, with an epidemic condition that has been prevailing in Japan occasionally for perhaps half a century, but there were certain features of dissimilarity which had to be admitted.

One of the most important of the questions we are called upon to consider is this: To what extent are man's efforts, aimed directly at the control and suppression of disease, effective? I am compelled to confess that those of us concerned especially in preventive medicine are likely to claim too much. Often we have failed to take into account that epidemics may come and go without much regard for what we do or fail to do. There is coming into existence a more sane attitude on this point and we find ourselves adopting a more critical attitude towards our efforts at disease prevention, and when we attempt to appraise the results of our own efforts we take into account as well the operation of natural causes which we are not able to control. Let me give you as an example of a disease in the control of which I think there is no question but that purposeful measures have

been highly successful. I have in mind yellow fever. Many of us remember when it occurred all too frequently in epidemic form in the United States, and was practically always present in tropical America. Then came the brilliant studies of the army commission made up of Reed, Carroll, Lazaer, and Agramonte, work which showed that in a certain species of mosquito lay the secret of the spread of the disease. This was followed by the work of the administrative authorities who showed that by attacking the mosquito, attacking it especially at the most vulnerable point, the breeding places, the chain of events leading to the epidemic could be broken and the disease prevented or promptly eliminated if it already had gained a foothold. Here was a disease, the elimination of which from the world seemed readily feasible, and one of the great international public health agencies set for itself the task of freeing the world of yellow fever. The task was begun perhaps 20 years ago and it may be said without doubt that great good has been accomplished but it may be said, equally without doubt, that the goal appears no nearer now than when the work was begun. True, the disease has been readily suppressed in the important ports and other cities of the world but it has been found to lurk in the more remote places, places in which the attack on it is much more difficult. It has been found, too, that more than one species of mosquito may carry the disease, and finally, that atypical clinical cases may serve as foci of spread. In spite of these facts, let me say that on the whole the results of the warfare on yellow fever have been brilliant, though falling short of our expectations.

Now let me give you an example of a disease in which the problem of elimination seemed to be even more easy of solution than that of yellow fever. I refer to pellagra, a nutritional, or dietary, deficiency disease very prevalent in our Southern States and in certain other parts of the world. The brilliant experimental work of Goldberger and his associates showed that the only thing needed to prevent the development of pellagra in an individual and even to cure it if already developed was a suitable diet. When it came to practical application of the experimental findings on a large scale, difficulties were encountered. It was not, and is not, easy to modify the dietary customs of large groups of people and, of course, the economic factor usually is the predominant one since a "suitable" diet costs more than the relatively inexpensive diet which often leads to the development of pellagra. So we still have a disgraceful amount of the disease, if we think in terms of how much we know about it and how easy is its prevention, but probably we have no more than is inherent in dietary

customs and the economic status of the parts of the world in which pellagra prevails.

In this day when smallpox is so rare that many physicians go through a busy professional career without seeing a case, it is difficult to credit the statement that there was a time, not so long ago, when English employers of domestic servants made it a condition for acceptance into service that the prospective employee should have had smallpox in the natural fashion. Perhaps the prevalence of no other disease, has been so much influenced by direct attempts at control as this one. Contrast the experience of Boston, 1721, when about 6,000 were attacked in a population of 10,500 with the experience of today when the disease is so readily controlled by vaccination that it has ceased to be a major scourge. While not yielding to anyone in honoring Jenner for having given us vaccination, I must remind you that before his day there was a crude method of prevention of smallpox based on the same principles used by Jenner. Purposeful inoculation of smallpox itself usually gives rise to a mild form of the disease which protects against an attack acquired in the natural way. This method antedates the Christian era.

It is significant of the changed attitude of the population as to its social responsibility that inoculation, the precursor of vaccination, was chiefly practiced among the well-to-do, that is among those who could pay for it. Nowadays a child has a poor chance to escape vaccination, be he poor or rich.

I will now discuss briefly two diseases that have become relatively rare, due, in my opinion, not so much to man's direct attempts to control them but to influences concomitant with the advance of civilization.

The "black death" of the 14th Century usually is identified with plague of more recent times, but the accounts that have come down to us give no sure grounds for insisting on the identical nature of the two. When we read of the disease in those days being so virulent as to infect swine (animals never attacked by plague as we know it), our skepticism seems well founded. On the other hand, some of the clinical descriptions seem to leave little choice but to call the disease plague. Whatever the nature of that early epidemic may have been there is no doubt as to its destructiveness. Thus, three out of every 5 in Florence are said to have died; in Italy as a whole and, indeed, in England, half of the population of that day died from this disease. This outbreak gave us one notable, crude advance in preventive medicine, the genesis of quarantine systems. In the early form it con-

sisted of arbitrary detention of ships at ports still uninfected for 40 days after their arrival from an infected country. I have said it was crude, but no more crude than the measures taken by some governmental authorities within the past few months in connection with the spread of the epidemic of poliomyelitis which occurred last summer, and it is to be said that the earlier attempts to quarantine and the later ones are about equally ineffective.

The London plague of 1665 is said to have killed 98,000 among a population of one-half million. We have had what we consider pretty bad outbreaks in modern times (notably British India) but there is nothing to even remotely approximate the London experience. Happily, it is now recognized that plague will not become a menace in any modern community. We owe this fortunate state of affairs not so much to any intensive improvement in sanitation but rather to changes in our environment which have put us on less friendly terms with the rodent population. It is suggested that the complete obliteration of plague in England was due to the fact that the black house rat, which came in close contact with man, was driven out in the 18th century by the brown rat, which ordinarily is not found in such close association with man.

I have spoken of the relative freedom the world now enjoys from plague but I might possibly be charged with too much optimism did I fail to tell you that once before, for a period of about 7 centuries, England remained free from plague, that is, between the Justinian plague of the 7th century and the other outbreak of the same disease known as the "black death" in the 14th century.

The fact that leprosy is the only definite clinical condition mentioned in the Bible, and the space given to it there, indicates how important a problem it was in those days. This disease was so prevalent in Europe in the Middle Ages that leprosy isolation hospitals were numbered by the thousands while today in the whole civilized world they may be numbered only as a few dozen. It may be stated here (though not necessary to the present discussion) that there is good authority for the statement that the leprosy hospital often formed the nucleus of the general hospital after the former ceased to be used for the special purpose for which it was constructed, and, further, that many of the great European hospitals of today go back to such humble origin.

It is interesting to observe how the ideas of the race as to the cause of leprosy have varied from time to time. Thus, in biblical times the injunction for sanitary administrative control such as Moses laid

down spell out a clear recognition of the fact that the disease was considered communicable, or, as often stated, that "leprosy begets leprosy." Then came a period of several centuries in which it was looked upon as not communicable. By the latter part of the middle ages hard experience had forced into the minds of man the fact that the disease did spread, and those who suffered from it were a menace to the health of those around them, hence the large number of asylums referred to as having existed at that period. This view prevailed until well into the 19th century. In 1867, the Royal College of Physicians (London) declared leprosy to be non-contagious. A little later came the studies of the great Norwegian, Hansen, who established the infectious and communicable nature of the malady, a fact so generally accepted at the present time that we have difficulty in appreciating that for long periods the minds of men rejected the communicability of the disease. The facts at hand do not justify any other conclusion as to the spread and decline of leprosy at different periods and in different countries. I venture the suggestion that leprosy is to be regarded as an epidemic disease which rises and falls due to circumstances beyond our knowledge and largely beyond our control. It differs from other infectious diseases, however, in that the cycle covers one to several centuries whereas with most other epidemics the cycle is completed in a few weeks, or a few months at the outside. I can make this suggestion with much safety to my professional reputation since no one can disprove it today, and it will take several centuries to prove it if it chances to be well founded.

In conclusion, I will mention problems presented by an epidemic disease that has not been influenced in respect to prevalence either by purposely directed efforts or by the onward march of civilization and progress.

I am a member of a group charged with certain responsibilities in connection with researches on influenza and other respiratory diseases and rarely do we meet without some discussion, often disputes, as to just what influenza is. The questions most frequently asked, and never answered, are: 1. Are the various pandemics that occur at intervals of 20–30 years due to the same virus? Tentatively, the answer is yes. 2. A much more difficult question is as to the interepidemic prevalence of the disease. Are these relatively mild outbreaks due to the same virus that causes the pandemic outbreaks or are they due to different viruses? There is no agreement on this point and we must keep an open mind. Until we have some new method of approach enabling us to identify the causative agent with certainty,

speculation is rather futile. In the meantime, the term "influenza" is likely to continue to be used by physicians and laymen for miscellaneous respiratory disorders to which no other diagnosis is readily applicable. Perhaps what I have just said may be made somewhat clearer by the explanation that the diagnosis of true influenza is based more on the characteristics of the epidemic prevailing at the time than on the manifestations in the individual patient. In 1918, one could say with much confidence that any group of patients had influenza but in 1936 any small group or any single patient is not so certainly disposed of from the point of view of diagnosis. In the epidemics, particularly in the pandemics, the outstanding features are widespread prevalence, high incidence, and lack of preference for any age, sex, social or racial group. It is true there are some variations in the attack rates for different age groups in different epidemics; nevertheless, what I have said is substantially correct. Another feature is the general progress of the disease from east to west. Always there is an interval of a few months between the appearance of the disease in, let us say, Moscow and in San Francisco.

The outbreak of 1918 and that of 1920 were the first to be studied by modern methods and yet I fear that the intensive and extensive studies carried on then, and later, have not resulted in any really helpful information so far as treatment of the disease and control of outbreaks are concerned. We did learn from the few experiences that strict quarantine measures would protect well isolated communities but that this was impracticable on a large scale. It was impracticable even for military camps, where requirements designed to protect could be made more rigid than for a civil community. Some communities, in attempting to control the disease, did things that in retrospect appear amusing. One west coast city required everyone to wear gauze masks over the mouth and nose, closed the churches, but, for readily understood reasons, did not close the saloons. Perhaps a story is worth telling to illustrate the situation. It chanced that the decline of influenza was about synchronous with the Armistice celebration in San Francisco and a physician friend of mine was accosted on the streets in the early morning of Armistice Day by a bibulous individual celebrating in true San Francisco style, and that means, to say the least, with enthusiasm. The bibulous individual was laughing and very voluble and my friend remarked to him that, of course, winning the war was wonderful but it scarcely seemed to justify the extreme kind of celebration in which he was indulging. The tipsy one replied hilariously that he was not celebrating the end

of the war but how wonderful it was to have a city with every church closed, every saloon open, and every woman muzzled!

[The speaker concluded his remarks by showing a series of slides depicting events and phenomena associated with past epidemics. Ed.]

BOTANY.—*Rock midget, a new species of* Mimulus *from Death Valley, California.*[1] FREDERICK V. COVILLE, U. S. National Herbarium.

The plants of Death Valley, California, are of special interest because they exist under conditions of extreme heat and aridity. This interest has become much more widespread since Death Valley was made a national monument, in 1933. More than 42,000 persons visited the valley in 1935. My own *Botany of the Death Valley Expedition*, published in 1893, is still the principal work of reference on the plants of Death Valley. In the process of preparing a new account of these plants, several species new to science have been found and published. Another is described in the present paper. Its specific standing has been confirmed by Dr. Adele Lewis Grant, author of *A Monograph of the Genus Mimulus*, 1924. The illustration (Fig. 1) is from a photograph made by Mr. B. Anthony Stewart, of the National Geographic Society. To him and to the Society I am indebted for the privilege of publishing it.

Mimulus rupicola Coville & Grant, sp. nov.

Annuus, Mimulo tricolori affinis, sed corollis brevioribus et pallidioribus, foliorum caulinorum apicibus et calycium lobis acutissimis, nec obtusis; pedicellis fructiferis recurvatis, deinde porrecte curvatis, nec rectis; capsulis falcatis, acutis, puberulis, a sutura convexa mox dehiscentibus, nec, modo M. tricoloris, ovatis vel oblongis, obtusis, glabris, et tardissime dehiscentibus. Fissuras rupium calcariarum montibus eremis Vallis Mortis, nec, ut M. tricolor, locos aquosos exsiccantes Californiae intramontanae, habitat.

Plant belonging to the section Oenoe, annual, 2 to 15 cm in height, beginning to flower when very young and with only a few leaves, all basal, the plants later becoming much branched from the base; stems densely glandular-pubescent to glandular-villous; basal leaves 2 to 6 cm long, 2 to 10 mm wide, the elliptical-lanceolate to linear-lanceolate or oblanceolate blades narrowed at the apex to a usually blunt point, and tapering very gradually at the base into a petiole often as long as the blade and margined for most of its length, entire or rarely with an irregular tooth, glandular-pubescent, often rather sparingly, the margins and petiole often glandular-villous; stem leaves opposite, up to 15 mm in width, elliptical-oblong, acuminate to a usually very acute tip, narrowed below to a short margined petiole, glandular-pubescent, usually densely so, and often glandular-villous; flowers occurring singly in the axils of the leaves; pedicels glandular-hairy,

[1] Received December 21, 1935.

at first commonly 1.5 to 2 mm long, and straight, in fruit sometimes increasing in length to 4 mm and bent sharply downward and to one side at the base, then, above, forward and outward, twisted half way round, becoming hard and woody and solidly attached to the rigid stem and to the base of the capsule; calyx usually 10 to 12 mm long, sometimes 13 mm, in depauperate plants sometimes only 6 mm long, plicate, scarious below the sinuses, glandular-pubescent, and sometimes with a few longer, soft, gland-tipped

Rock midget, *Mimulus rupicola* Coville & Grant, sp. nov. Natural size.

hairs, the throat oblique, the teeth very unequal, ciliate, triangular-ovate to triangular-lanceolate, attenuate to slender, often filiform, very acute tips, the posterior tooth 2 to 4 mm long, about twice the length of the others, reaching 2.5 to 4 mm farther than the two anterior teeth; corolla about two and a half times the length of the calyx, usually 20 to 30 mm long, in depauperate plants sometimes only 15 mm, the tube, throat, and lower part of the lobes sparingly glandular-puberulent, tube slender, yellow, about twice as long as the calyx tube, expanding rather abruptly to a funnelform throat, this yellow, with small purple spots and densely clothed within, on the

yellow anterior areas at the mouth, with large, yellow, club-shaped hairs, lobes rose-colored, sometimes almost white, approximately equal, commonly 2.5 to 5 mm in length and a little more in breadth, each with a conspicuous maroon spot at the base, or the spot sometimes wanting on the lower lobe, or even on all the lobes; stamens 4, included, the filaments arising from the corolla tube at a distance of about one-third the whole length of the corolla from the base, glandular-hairy for a millimeter or two at the base, smooth above, the posterior pair about 4 mm long, the anterior pair 2 to 3 mm longer; anthers smooth, connivent in pairs, the four anther cells of each pair about 1 mm long and nearly as broad, forming a cross, and dehiscent by slits for their whole length; ovary about 2 to 2.5 mm long to the end of the acuminate tip, 2-celled, with many ovules; style included, a little longer than the longer pair of stamens, sparingly hairy, the hairs short and gland-tipped; stigma peltate-funnel-shaped, about 1.5 mm high and 2 mm or more wide, the margin fringed with glandular hairs; capsule cartilaginous, lanceolate, somewhat sickle-shaped, somewhat compressed, the convex margin toward the back (the longer-toothed side) of the calyx, up to 9 mm in length, acute, puberulent, with a groove on each side opposite the placentae, dehiscent by a narrow slit from apex to base on the convex margin and a third or less its length from the apex on the concave margin, the convex, originally posterior margin standing outward and below at maturity and the concave margin inward and above, because of the twist in the fruiting pedicel; seed light brown to blackish brown, narrowly elliptical in outline, terete, abruptly contracted at the apex into a distinct beak, the body 0.7 to 1 mm long, 0.3 to 0.4 mm thick, minutely reticulated at full maturity, the areolae rectangular.

Type specimen in the United States National Herbarium, no. 1,630,865, collected on the foot of Nevares Peak, Funeral Mountains, Death Valley, California, altitude about 2,500 feet, April 6, 1935, by M. French Gilman (no. 1251), with both flowers and fruit. Collected also at the same locality, which is near Cowcreek, April 23, 1932, in flower (*Coville & Gilman* 400), March 18, 1935, in flower (*Gilman*), and in October, 1935 (*Gilman*), with an abundance of fruit on the dead stems. It was first found by Mr. Gilman in Cottonwood Canyon, Panamint Mountains, April 21, 1932 (*Coville & Gilman* 360), in flower, altitude 900 feet. The species has been collected also in Titus Canyon, Grapevine Mountains (*Gilman* 1196, April 29, 1935, past flowering). In all these localities the plants grew in the shaded crevices of limestone rocks.

The conspicuous flowers, rose-colored to almost white, with a large maroon spot at the base of each corolla lobe, and a golden throat; the habitat of the plant, in the shaded crevices of rocks; and its small size, all combine to give the species charm. The plant sometimes begins to flower when it is less than an inch in height and has only basal leaves. The larger specimens, up to 6 inches in height, are much branched from the base. A curious characteristic of the species is the position of the fruit. When the flowers open, the flower-stalk is straight and the long tooth of the calyx stands uppermost in the flower. Later the flower-stalk bends abruptly downward and to one side, and then upward and outward, in a sigmoid curve, and at the same time it twists about 180 degrees, until the long tooth of the calyx is on the lower side, the result being that the capsules, which are somewhat sickle-shaped,

stand out from the stem like the rustic coat-hooks of a log-cabin camp. The narrow slit in the ripe cartilaginous capsule is then on the lower and outer side, a position that presumably facilitates the scattering of the seeds. The fruits of some of the later (upper) flowers assume this position only partially, as if drouth and death had come too soon. In such cases the capsule is often straight and the split imperfect.

For more than three hundred years it has been generally admitted that a rose by any other name would smell as sweet. Without question, too, a rose would smell as sweet without a name. But it is my belief that any plant of sufficient interest to attract public notice should have a popular name as well as a Latin name. Plants of the genus *Mimulus* are commonly called monkeyflower, because their two-lipped corollas suggest a monkey's face. The present species, however, belongs to a group in which the corollas are not definitely two-lipped. This group of species has sometimes been separated from *Mimulus* as a distinct genus, *Eunanus*. The name *Eunanus* means a dwarf. I suggest for these dwarf species of *Mimulus* the common name, midget, and for this new species from Death Valley the common name, rock midget. The accompanying illustration will, I hope, confirm the propriety of this suggestion. Not all the plants of the desert are protected from heat and drouth by special adaptations, such as the absence of leaves, and the internal storage of water. In the present case the habitat itself lends protection to an annual that is tiny, thin-leaved, and delicate. Like the conies of ancient Palestine, the plants of this new species "are but a feeble folk, yet make they their houses in the rocks."

BOTANY.—*Leaf venation as a means of distinguishing* Cicuta *from* Angelica.[1] MIRIAM L. BOMHARD, U. S. Forest Service. (Communicated by FREDERICK V. COVILLE.)

The close resemblance of poisonous waterhemlocks (*Cicuta* spp.) to certain harmless umbellifers, particularly wet-habitat species of *Angelica*, indicates the importance of ascertaining diagnostic characters by which the waterhemlocks may be distinguished. Numerous and sudden fatalities have been caused by *Cicuta*, not only among domestic livestock but among human beings, especially children. The extremely toxic character of the underground parts ranks this genus as one of the most virulently poisonous groups of flowering plants native to the North Temperate Zone. *Cicuta* is chiefly a North American

[1] Received January 27, 1936.

genus, being widely distributed in wet places practically throughout the continent. Only one species, *C. virosa*, occurs in Europe and Asia; it is considered such a menace in some parts of northern Germany that its extermination is ordered by law.[2]

Because of the general resemblance of their compound leaves and white-flowered umbels, waterhemlocks are most often confused with species of *Angelica* in the western United States and Canada where both genera are well represented and widely distributed, and where angelicas characteristically grow in moist or wet situations.[3] Waterhemlocks are also sometimes mistaken for species of *Osmorhiza*, or for the woollyhead-parsnip (*Sphenosciadium capitellatum*), and some other members of the parsley family, many of which are excellent forage plants.[4] The fruits, it is true, provide a dependable means of recognizing all the genera mentioned. The flower clusters of *Osmorhiza* and *Sphenosciadium* are also sufficiently distinctive to serve for unmistakable recognition, but those of *Cicuta* and *Angelica* can scarcely be distinguished with certainty by persons not technically trained in botany. When neither the fruits nor flowers are present and the foliage alone must be depended upon for identification, accurate determination in the case of *Cicuta* and *Angelica* is often impossible on the basis of the leaf characters now used, and, as will be discussed later, the internal structure of the root crown or rootstock has proved to be unreliable as a guide in recognizing waterhemlocks.

The writer recently had occasion[5] to make a critical comparison of herbarium specimens of *Cicuta occidentalis*, the most widely distributed waterhemlock in the West, and *Angelica lyallii*, one of the most common and valuable forage species of the angelicas, and was impressed by the striking contrast in the venation of their leaflets. As is usual in serrate leaves, the secondary veins proceed toward the middle of the marginal teeth in the leaflets of *A. lyallii*, but in *C. occidentalis* they apparently end in the notches between the teeth. Such a definite difference in the venation of this representative species of a poisonous genus suggested the possibility of its usefulness as a diagnostic generic character.

[2] THELLUNG, ALBERT. *Umbelliferae*, in HEGI, GUSTAV. *Illustrirte Flora von Mittel-Europa* 5: 1166. 1926. Munich.

[3] This was strikingly illustrated on a California range a number of years ago where *Angelica breweri* was eradicated at considerable expense in the belief that it was a waterhemlock. The writer's attention has also been called to a recent toxicological investigation made on a species of *Angelica* under the misapprehension that it was a species of *Cicuta*.

[4] The fact that waterhemlocks are also confused with toxic umbelliferous genera, such as *Berula*, *Oxypolis*, and *Sium*, need not be considered here.

[5] In connection with the preparation of the *Range Plant Handbook*, a forthcoming publication of the United States Forest Service.

A review of the literature relating to *Cicuta* brings to light that Bigelow,[6] in the first volume of his *American Medical Botany*, published in 1817, was probably the first to note that, in the eastern spotted waterhemlock (*C. maculata*), "The veins end in the notches, and not at the points of the serratures"; his excellent colored plate clearly shows the leaf venation. Rafinesque's description of this species also mentions "with veins ending at the notches, which is very unusual."[7] Torrey and Gray[8] refer to this characteristic venation of *C. maculata*, but credit Darlington[9] (instead of Bigelow) with first having observed this feature. In the first five editions of Gray's *Manual of Botany*, the termination of the veins in the notches of the leaflets is given in the description of the genus *Cicuta* which included only *C. maculata* and *C. bulbifera*. In 1868, Gray published his new species, *C. californica;* in the original description, he states, "venis primariis tenuibus in dentes disinentibus,"[10] and definitely points out that this differs from the venation of *C. maculata*. Gray's observation that the veins run to the teeth in *C. californica* no doubt accounts for the omission of reference to leaflet venation in generic descriptions of *Cicuta* in subsequent editions of his *Manual*, even though this native California species is quite outside the geographic range of that work. However, the characteristic venation of the leaflets of the eastern spotted waterhemlock has long been recognized as specific and is referred to in several of our standard manuals which describe the plants of Canada and the southeastern or eastern United States and in various publications on poisonous or medical plants.

It is remarkable that none of the current plant manuals and floras of western North America mention this similar peculiarity of venation for any of the western waterhemlocks. Chesnut and Wilcox[11] published, in 1901, a very good figure of western waterhemlock (*C. occidentalis*) clearly showing the termination of the veins in the notches of the leaflets but not calling attention to this feature in the text. Certain other investigators of poisonous plants have used illustrations showing the venation of this species; Jacobson[12] mentions it when

[6] BIGELOW, JACOB. *American Medical Botany* 1: 127, pl. 12. 1817. Boston.

[7] RAFINESQUE, C. S. *Medical Flora; or, Manual of the medical botany of the United States of North America* 1: 108, fig. 22. 1828. Philadelphia.

[8] TORREY, JOHN, and GRAY, ASA. *A Flora of North America* 1: 610. 1840. New York.

[9] DARLINGTON, in his *Flora Cestrica* (1837), does call attention to the termination of the veins in the notches of the leaflets of *C. maculata*.

[10] GRAY, ASA. *Characters of new plants of California and elsewhere.* Proc. Am. Acad. Arts & Sciences 7: 344–345. 1868.

[11] CHESNUT, V. K., and WILCOX, E. V. *The stock-poisoning plants of Montana; a preliminary report.* U. S. Dept. Agr. Div. Bot. Bull. 26: 80–86, pl. 7. 1901.

[12] JACOBSON, C. ALFRED. *Water Hemlock (Cicuta).* Univ. Nevada Agr. Exp. Sta. Tech. Bull. 81: 15. 1915.

describing the "*Cicuta occidentalis-vagans* group." Greene's original descriptions of *C. ampla* and *C. arguta* refer to the trend of the veins but, unfortunately, the meaning is ambiguous.[13]

No statement as to the possible importance of leaflet venation as an aid in recognizing other species of waterhemlocks has come to the author's attention. In order to discover whether this character could be used in distinguishing *Cicuta* from *Angelica*, the writer has examined all the available herbarium specimens (over 1,800) of these two genera in the collections of the United States Forest Service, the New York Botanical Garden, and the United States National Herbarium. Even without the aid of a hand lens, the principal veins are, for the most part, clearly visible on the under side of the leaflets, especially in *Cicuta*. It was found that the secondary veins of the leaflets are definitely directed toward the notches in all the species of *Cicuta* except *C. californica*. In those species in which this character is most clear-cut and easily recognized, the veins apparently end in the notches of the leaflet margins. The actual termination of the veins may be seen upon closer examination; enlarged cuts showing the venation of several of the marginal teeth of the leaflets of five species of *Cicuta* (Fig. 1.—A, B, C, D, E) make clear that it is the *direction* or *trend* of the veins toward the notches which must be recognized as diagnostic, since the veins or their branches continue beyond the notches along the edges of the teeth, either coinciding with the margin or running more or less parallel to it, terminating in the frequently spinulose tips of the teeth. This is in direct contrast to the condition in *Angelica*, where the secondary veins proceed directly toward the middle of the teeth, notwithstanding the fact that subsidiary veins branch off to the notches and continue along the margin, as can be seen in the enlarged illustrations of the marginal teeth in two species of *Angelica* (Fig. 1.—F, G).

This distinctive venation of the waterhemlocks is obvious in *Cicuta maculata*, *C. curtisii*, *C. occidentalis*, *C. bolanderi*, *C. douglasii*, and in the European *C. virosa*. Particularly in the first four of these species, the veins are more or less elevated and widely spaced; their trend in the direction of the notches of the coarse, evenly spaced serrations may be determined at a glance. The fact that the leaflets of some specimens of *C. douglasii* tend toward an incised-serrate margin (Fig. 1.—E) must be taken into consideration when noting the veins in this species; in some of the deeper serrations, the veins proceed to

[13] GREENE, EDWARD L. *New species of Cicuta*. Leaflets 2: 241, 238. 1910–1912. Washington, D. C.

the middle of the teeth (behaving much as midribs), although they are directed toward the notches in the majority of the serrations precisely as in other specimens in which the margin is not incised but evenly and coarsely serrate. In *C. vagans*, the veins proceed toward the notches but tend to become much less prominent near the margin, especially in the upper portion of the leaflets. *C. bulbifera* is a distinctive species bearing clustered bulblets in the axils of the upper reduced leaves; its slender leaflets, remotely serrate above and often

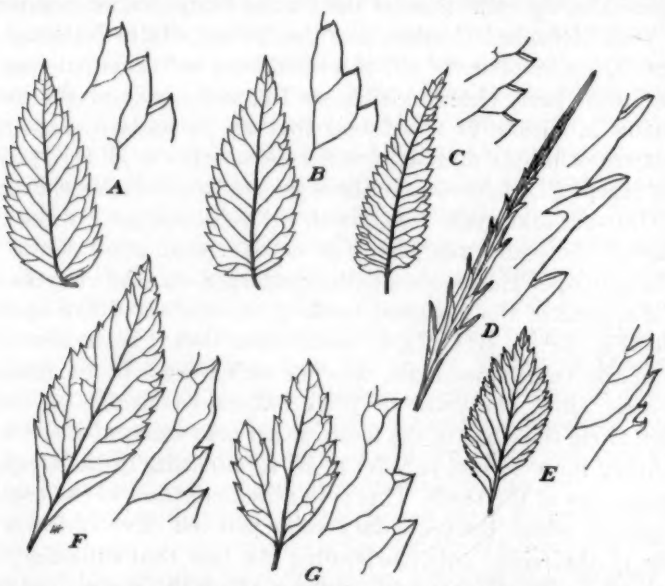

Fig. 1.—Leaflet venation in *Cicuta* (A–E) and *Angelica* (F, G). A, *C. occidentalis;* B, *C. curtisii;* C, *C. bolanderi;* D, *C. bulbifera;* E, *C. douglasii;* F, *A. lyallii;* G, *A. breweri.* Leaflet in A, B, C, E, F, and G, one-half nat. size; D, nat. size. Detail of marginal teeth to the right of each leaflet, one and one-half nat. size; D, twice nat. size. Drawn by Leta Hughey.

lobed below, may be so delicate that the direction of the veins cannot be clearly seen without the aid of a lens (Fig. 1.—D).

The only exception to the rule that in *Cicuta* the veins apparently end in the notches of the leaflets is *C. californica*, but this species is exceptional in other respects as well, and is certainly not a typical *Cicuta*. California waterhemlock is practically an aquatic and has a rather restricted range in coastal California. There is no possibility of confusing it with either of the two species of *Angelica* (*A. hendersonii* and *A. tomentosa*) which occur within its range because these

angelicas may be recognized by distinctive leaf differences other than venation.

In all the species of *Angelica* examined, the veins proceed toward the middle of the teeth. *A. lyallii* (Fig. 1.—F) may be considered typical of the species occurring in the United States and Canada. *A. breweri* is illustrated (Fig. 1.—G) to emphasize the fact that, even though a branch vein is sent off to the notch, the secondary vein continues directly to the tip of the tooth. In some exotic species of *Angelica* which possess delicate, much divided, or otherwise distinctive leaves, recognition of the characteristic form of the leaflets renders the traditional vein-to-tooth character relatively unimportant.

Since Thellung[14] reports that, in Europe, *Cicuta virosa* is sometimes confused with *Angelica silvestris*, which in the earlier stages of growth furnishes forage for cattle, particular attention was given to an examination of available herbarium specimens of these two species. It was found that the veins are easily traced toward the notches in the narrow, lanceolate to linear, sharply serrate leaflets of *C. virosa* and directly to the middle of the teeth in the ovate leaflets of *A. silvestris*. This difference in venation has apparently been overlooked by recent European investigators who mention only the narrowness of the leaflets and the usual chambered character of the root crown as aids in identifying the poisonous waterhemlocks. Attention is called, however, to the fact that the root crown is occasionally solid.[15]

Recognition of the presence of cross-partitions in the underground parts of waterhemlocks has been strongly advanced as an infallible guide in identifying these plants. This is, however, by no means a trustworthy criterion, because, although it is true that transverse partitions are characteristic of the root crown or rootstock of older plants of all the waterhemlocks, these partitions are sometimes obscure, and, in younger plants, are often absent. Moreover, many species of *Angelica* (*A. lyallii*, *A. ampla*, *A. breweri*, etc.) sometimes have well-marked cross-partitions in their roots. In fact, the development of chambers in the thickened underground parts has been observed in various members of the *Umbelliferae*.

The distinctive venation of the waterhemlocks should serve as a convenient field character for the recognition of these dangerous plants and should prove particularly useful in the identification of young plants early in the spring when there is most danger of livestock-poisoning.

[14] THELLUNG, ALBERT. Op. cit., p. 1338.
[15] THELLUNG, ALBERT. Op. cit., p. 1164.

PALEOBOTANY.—*A fig from the Eocene of Virginia.*[1] EDWARD W. BERRY, Johns Hopkins University.

The Eocene of Maryland and Virginia comprises a series of exclusively marine and often highly fossiliferous sediments segregated into an older Aquia and a younger Nanjemoy formation which were described in detail in 1901 by Clark and Martin.[2] Traces of the land vegetation of the time are represented by occasional drift fruits and fragments of wood.

The rather extensive investigations leading up to the report cited above resulted in the discovery of only a single plant—fruits determined by Hollick (Idem., p. 258, pl. 64, figs. 11, 12) as two varieties of a botanically unidentified species of *Carpolithus*. During the last 35

Fig. 1.—A probable fossil fig from Pense, Saskatchewan. Fig. 2.—*Ficus aquiana*, n. sp., from Belvedere Beach, Prince George County, Va.

years fairly continuous collecting has been prosecuted at the more prolific Eocene outcrops but it was not until the summer of 1933 that an identifiable land plant was discovered. This was a fairly complete cone of a pine[3] from near the type locality of the Aquia at Belvedere Beach, Prince George County, Va. Continued exploration of the excellent section at Belvedere Beach resulted in the discovery by R. L. Collins, during the summer of 1935, of a fruit of *Ficus*. This is much the most convincing fossil fig that I have ever seen, being more characteristic than the remarkable *Ficus ceratops* Knowlton[4] which is so abundant in the Lance formation of Montana, Wyoming, and western Canada. The new species may be named in allusion to the horizon which is not many miles from the type locality of the formation.

[1] Received November 11, 1935.
[2] CLARK, W. B., and MARTIN, G. C. *Eocene.* Md. Geol. Survey. 1901.
[3] BERRY, E. W. This JOURNAL 24: 182, 1934.
[4] KNOWLTON, F. H. Torrey Bot. Club Bull. 38: 389, figs. 1–4, 1911.

Ficus aquiana, n. sp. Fig. 2

In life this fig must have been approximately spherical. As a flattened fossil, there is a slight narrowing in the region known as the neck in the pyriform species, but the scar of attachment is invaginated with the body of the fig pushed forward on one flat side and backward on the other. The eye is open and relatively large, about 9 x 5 mm, with its edges somewhat thickened. The interior of the specimen was filled with sediment and no traces of seeds were observed, indicating that the plug or scales had rotted away while the fruit was floating and that the sediments which filled the interior entered through the eye, as the walls were perfectly intact when the specimen was collected. In modern figs of comparable size the eye is closed to a greater or less extent by scales of various forms. That this was the case in the fossil is indicated by the prominence of the vascular bundles on the thickened lip.

The ribs are numerous and well shown in the photograph. The walls of the fruit (properly the receptacle) are relatively thin and the cavity large and filled with sediment. This feature as well as the fact that this fruit floated from the land (probably stream borne) and became filled and covered by sediment and was lignified, is rather conclusive evidence that in life it was dry and woody instead of fleshy, as otherwise it would have rotted and failed of preservation. Its dimensions are, as preserved, about 4 cm in length, about 3.7 cm in diameter, and about 1.5 cm in thickness.

I have, unfortunately, no complete collection of the fruits of existing species of Ficus. One unidentified woody specimen is identical in surface ornamentation, but has a smaller eye and a shape like *Ficus ceratops*. The most similar recent fig seen is a specimen of *Ficus repens* Rotel collected by F. N. Meyer near Soochow, China; but I do not know if this specimen is typical of the species. It is about the same size as the fossil with similar thin woody walls. The ribbing is slightly less prominent on the outer surface. The actual eye is smaller but the apex is invaginated around the latter for about the area of what I have called the eye in the fossil and has the appearance of offering the possibility of macerating out to match the fossil. The general form is similar, i.e., roughly globular and inflated, but is produced into a short and slender neck. If the latter were softened by maceration and pushed during a compression similar to that undergone by the fossil, the result would not be very different. There is a possibility, although I regard it as remote, that my interpretation is wrong, and that what I regard as the base and the scar of attachment is the plugged eye, and what I regard as the eye is the broken neck. The lack of any reasonable explanation for such a break where the vascular strands would be concentrated, or for the opening to be symmetrical and lipped, seems to invalidate such an interpretation.

Occasional fruits of Ficus have been encountered and described from strata ranging in age from Upper Cretaceous to late Pleistocene. Except for casts in Pleistocene tuffs or travertine in France and Italy, these are mostly lignified, structureless and unsatisfactory objects for study. Exceptions to this statement are the present specimen and the late Upper Cretaceous or early Eocene form from the West referred to above and described by Knowlton in 1911.

In this connection I am figuring an object sent me by B. F. Baxter of Pense, Saskatchewan, from approximately the same horizon as *Ficus ceratops* Knowlton. This is a chalcedony pebble with faint indications of ribs and a pronounced umbilicus which might very well represent a fig "eye," since the eye-like plug is surrounded by a narrow cavity into which a fine needle can be inserted a distance of 4 mm inside the rim or lip. In color and form it bears a striking resemblance to a modern fig, but it would be unsafe to press such an identification without sacrificing the single specimen, and even this might not yield results. It seems to me that this probably represents a fig which has been replaced by chalcedony since it is hard to conceive of a pebble with an umbilicus and radial markings. On the other hand if it is of organic origin one would expect more than a single specimen. If additional specimens are found I would not hesitate to consider its identity as proved.

I have records, doubtless not complete, of 402 named species of fossil figs. The majority of these are based upon leaf impressions ranging in age from mid-Cretaceous to Recent. Doubtless a considerable number of these may be wrongly identified, but the majority can scarcely be disputed especially since they are occasionally associated with fruits. It would be an interesting speculation as to whether the setting of seeds in an Eocene fig required the intervention of ancestral *Blastophaga* wasps as is the case with some of the best cultivated figs. All of the several hundred existing species of figs do not however require caprification, but certainly the form of the fruit-multiple flowered on the inside of a hollow receptacle is to be correlated with insect pollination of some kind and if this be granted the habit was already established at the dawn of the Tertiary.

Much has been written of the place of origin of fig culture, Solms-Laubach suggesting southern Arabia, which seems doubtful to me. None who have written on this fascinating subject have had any knowledge of the fossil record or of the presence of *Ficus carica* (the edible fig) in Interglacial deposits (2nd and 3rd Interglacial) in both France and Italy, both fruits and leaves being found and both in this case highly characteristic. Fruits supposed to represent this species have even been described by Engelhardt and Kinkelin from the Pliocene of south Germany, but their identification is not so certain. A great many recent species other than *Ficus carica* are eaten occasionally or regularly in different parts of the world. Sturtevant (1919) names 18 species which are eaten regularly or in times of scarcity of food, and doubtless many more are occasionally eaten. I would not be

surprised if it were eventually shown that wild figs were present throughout the Mediterranean basin and were an article of diet of Paleolithic man, which is quite apart from the question as to where dried figs first became an article of commerce, which may well have been in eastern Mediterranean countries. The genus *Ficus*, as aforesaid, is a large one in modern floras with between five and six hundred species adapted to a variety of habitats, but confined to the warmer parts of the world, although by no means confined to the tropical zone.

The Eocene has yielded a prolific flora in the Mississippi embayment region and in western North America but practically nothing in eastern North America except the isolated lignite basin at Brandon, Vermont,[5] from which a large number of fruits and seeds have been described. The latter, as well as the present species of *Ficus*, indicate climatic conditions more genial than those indicated by the plants known from the Chesapeake Miocene, and probably somewhat more genial than the corresponding latitudes of the present day, but certainly to be denominated temperate, rather than tropical or even subtropical.

ZOOLOGY.—*New pocket gophers of the genus* Thomomys.[1] E. A. GOLDMAN, Bureau of Biological Survey.

Twenty years have passed since the pocket gophers of the genus *Thomomys* were revised by Bailey (North Amer. Fauna, No. 39: p. 1–136, Nov. 15, 1915). Much additional material has become available for study, and the tendency toward the recognition by name of less and less strongly marked stages of differentiation has resulted in the description of many new forms, especially in the plastic *Thomomys bottae* group.

These extremely sedentary animals inhabit regions of highly diversified topography and climate. Populations consist of colonies which appear to be loosely and more or less intermittently in contact with neighboring colonies, or continuity of range may have become partially or completely interrupted by barriers associated with geological history. In such a setting full play has been given to forces that bring about localized modification, in response to environmental and genetic factors. The result has been the production of a profusion of forms, varying greatly in degree of minor differentiation, and yet maintaining the same pattern of more essential characters with remarkable

[5] BERRY, E. W. Am Jour. Sci. 47: 211–216. 1919.
[1] Received December 16, 1935.

fidelity. How many should be segregated, and whether particular ones are best designated by binomial or trinomial names are problems depending for ultimate solution on coördinated studies in the field and laboratory.

The criterion—presence or absence (observed or assumed) of individuals possessing intermediate characteristics—for distinguishing between species and subspecies is excellent in theory but not always satisfactorily applicable in practice. Uncertainty must exist where the number of specimens is insufficient to determine the range of individual variation, and where detailed knowledge of field conditions is lacking. A complicating factor is evidence that some forms may intergrade in one region and occur in close juxtaposition without apparent intergradation in another. Until the coördinated field and laboratory studies can be completed the choice of binomial or trinomial names must depend on individual judgment of the evidence in each case.

In the treatment of forms I have endeavored to be as consistent as possible. Experience in classifying pocket gophers, and many other mammals, has shown that trinomials may usually be applied with safety to populations exhibiting differential characters in combinations known to be of subspecific value only, elsewhere in the group.

Thomomys muralis, sp. nov.

Grand Canyon Pocket Gopher

Type.—From lower end of Prospect Valley, Grand Canyon, Hualpai Indian Reservation, Arizona (altitude 4,500 feet), No. 202580, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by E. A. Goldman, October 3, 1913. Original number 22264.

Distribution.—Isolated on terraces along the inner gorge, far below the outer rim in Prospect Valley, a lateral pocket within the Grand Canyon, near the eastern end of the Hualpai Indian Reservation, Arizona.

General characters.—A diminutive, ochraceous buffy species, separated from the ranges of the similarly-colored forms of the region by an interposed arm of the range of the darker subspecies, *Thomomys bottae fulvus.* Differing from *fulvus* in much smaller size, lighter color, and cranial proportions. Very similar in size and color, and bearing a close general resemblance to *Thomomys bottae desertorum,* but geographically isolated, and cranial details indicating no intergradation.

Color.—Type (acquiring fresh pelage): Upper parts between light ochraceous buff and ochraceous buff (Ridgway, 1912), purest along sides, thinly mixed with black on top of head and median dorsal area; outer sides of forearms light buff; thighs nearly pure white; under parts overlaid with white; muzzle blackish; ears entirely black along with the black postauricular patches usual in the group; feet and tail white. One of the topotypes is near tawny in general color of upper parts, with under parts overlaid with light ochraceous buff.

Skull.—Very similar in general to that of *T. b. desertorum*, but braincase more rounded and inflated, the basicranial region tending to bulge more prominently posteriorly; frontal region broader; premaxillae usually less extended posteriorly, the ends more nearly conterminous with nasals; upper incisors more strongly recurved (slightly more procumbent in *desertorum*). Compared with that of *T. b. fulvus* the skull is much smaller and more delicate in structure, and differs in detail in about the same characters as form *desertorum*.

Measurements.—Type: Total length, 194 mm; tail, 64; hind foot, 26. Two adult female topotypes: 182–190; 57–56; 24.5–25.5, respectively. *Skull* (type): Occipitonasal length, 33.2; zygomatic breadth, 20.5; breadth across squamosals (over mastoids), 17.7; interorbital constriction, 7; length of nasals, 11.3; maxillary toothrow (alveoli), 7.2.

Remarks.—The geographic isolation of *Thomomys muralis* in the Grand Canyon appears to be complete. In places it was found inhabiting strips of soil on ledges only a few feet wide, bounded above and below by vertical cliffs hundreds of feet high.

Specimens examined.—Four, all from the type locality.

Thomomys bottae desitus, subsp. nov.

Big Sandy River Pocket Gopher

Type.—From Big Sandy River, near Owen, Mohave County, Arizona (altitude 2,000 feet). No 227802, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by E. A. Goldman, September 21, 1917. Original number 23332.

Distribution.—Big Sandy River Valley and desert region southeastward to Wickenburg; probably also including the valley of the Bill Williams River, Arizona.

General characters.—Very similar in color and form of cranium to *Thomomys bottae desertorum* of Detrital Valley, but decidedly larger. Differing from *Thomomys bottae chrysonotus* of the Colorado River Indian Reservation, and *Thomomys bottae cervinus* of the Salt River Valley, in smaller size and more tawny coloration. About equal in size to *Thomomys bottae fulvus* of the Mogollon Plateau region, but color much clearer tawny, the back less mixed with black, and cranial details distinctive.

Color.—Type (acquiring fresh pelage): Upper parts in general between tawny and ochraceous tawny (Ridgway, 1912), only slightly darkened on top of head and middle of back by black-tipped hairs; outer sides of forearms light ochraceous buff; lower part of sides and thighs whitish; under parts overlaid with white, tinged with buff across throat and chest; muzzle blackish; ears black, except anterior margin which is buffy, the confluent black postauricular markings prominent; feet white; tail buffy above, whitish below, becoming white all around near tip.

Skull.—Essentially like that of *T. b desertorum*, but much larger. Compared with those of *T. b. chrysonotus* and *T. b. cervinus* the skull is much smaller, and less angular, the supraoccipital region more fully inflated (lacking the deep, median supraoccipital excavation usually present in *chrysonotus* and *cervinus*); audital bullae much smaller. Very similar to that of *T. b. fulvus*, but bullae larger.

Measurements.—Type: Total length, 230 mm; tail, 70; hind foot, 30.5. Two adult male topotypes: 219–238; 72–75; 30–31, respectively. An adult female topotype: 210; 62; 29.5. *Skull* (type): Occipitonasal length, 39.5; zygomatic breadth, 24.8; breadth across squamosals (over mastoids), 20; interorbital constriction, 6.8; length of nasals, 14.7; maxillary toothrow (alveoli), 8.2.

Remarks.—At the type locality *T. b. desitus* inhabits the loose sand along the broad alluvial river bottom, habitat in marked contrast with the harder upland soils perforated by its geographic neighbor, *T. b. desertorum*. The skull of *desitus* indicates close relationship to *fulvus*, and it is obviously a desert representative of the same group.

Specimens examined.—Total number, 22, all from Arizona as follows: Big Sandy River (near Owen), 5; Big Sandy River (Neale's Ranch, at 2,000 feet altitude), 7; Wickenburg, 10.

Thomomys bottae hualpaiensis, subsp. nov.

Hualpai Mountain Pocket Gopher

Type.—From Hualpai Peak, Hualpai Mountains, Mohave County, Arizona (altitude 7,000 feet). No. 227796, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by E. A. Goldman, October 6, 1917. Original number 23351.

Distribution.—Known only from the Hualpai Mountains, Arizona.

General characters.—A light ochraceous buffy subspecies of medium size. Closely allied to *Thomomys bottae desitus*, of the adjoining valley of the Big Sandy River; size about the same, but color distinctly paler; skull differing in detail. Similar in general to *Thomomys bottae desertorum* of the desert plains of the Detrital Valley to the north, but considerably larger and paler colored; cranial characters also distinctive.

Color.—Type: Upper parts near light ochraceous buff (Ridgway, 1912), clearest along sides, thinly mixed with black on top of head and over back; forearms and thighs pale ochraceous buff; under parts in general overlaid with pale ochraceous buff, varying to a deeper tint on throat and chest; a pure white spot on chin; muzzle blackish; anterior borders of ears invaded by buffy tone of head; rest of ears and postauricular spots deep black; feet white; tail brownish above on basal two-thirds, whitish below, and white all around on terminal third.

Skull.—Closely resembling that of *T. b. desitus*, but braincase somewhat lower; zygomata usually more slender; nasals more wedge-shaped, narrower posteriorly; audital bullae slightly smaller, dentition about the same. Compared with that of *T. b. desertorum* the skull differs mainly in decidedly larger size.

Measurements.—Type: Total length, 245 mm; tail, 78; hind foot, 31.5. *Skull* (type): Occipitonasal length, 40; zygomatic breadth, 25; breadth across squamosals (over mastoids), 20; interorbital constriction, 6.7; length of nasals, 14.8; maxillary toothrow (alveoli), 7.8.

Remarks.—This high mountain form most closely resembles its near geographic neighbor, *desitus*, but is distinguished by paler color. It requires

no close comparison with *chrysonotus* which is much larger and still paler, or with *fulvus* which is much darker.

Specimens examined.—Seven, all from the type locality.

Thomomys bottae internatus, subsp. nov.

Upper Arkansas River Valley Pocket Gopher

Type.—From Salida, Chaffee County, Colorado (altitude 7,000 feet). No. 150997, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by Merritt Cary, November 10, 1907. Original number 1247.

Distribution.—High valleys along the eastern side of the Rocky Mountains from the Upper Arkansas River Valley, Colorado, south to northeastern New Mexico.

General characters.—A large, ochraceous buffy or tawny subspecies. Closely resembling *Thomomys bottae pervagus* of the Upper Rio Grande Valley, New Mexico, but smaller; color very similar; cranial details distinctive. Similar in general to *Thomomys bottae ruidosae* of south-central New Mexico, but smaller; color much lighter, more uniform, not strongly mixed with black as in *ruidosae;* skull also different.

Color.—Type: Upper and under parts between ochraceous buff and tawny (Ridgway, 1912), the top of head and back faintly darkened by black-tipped hairs; muzzle blackish, except lips which are whitish; ears encircled by black; feet white; tail brownish above, white below, becoming whitish all around at tip. In some specimens the under parts vary to light ochraceous buff.

Skull.—Very similar to that of *T. b. pervagus,* but smaller and lighter in structure; premaxillae usually less extended posteriorly beyond ends of nasals; audital bullae smaller; dentition lighter. Compared with that of *T. b. ruidosae* the skull is larger and more angular, the temporal ridges more prominent; zygomata less strongly bowed outward posteriorly (widest anteriorly); maxillary arm of zygoma relatively heavier; dentition similar.

Measurements.—Type: Total length, 233 mm; tail, 74; hind foot, 32. Five adult female topotypes: 231 (220–239); 76 (73–80); 32 (31–34). *Skull* (type): Occipitonasal length, 39.1; zygomatic breadth, 24.2; breadth across squamosals (over mastoids), 19.7; interorbital constriction, 6.7; length of nasals, 13.9; maxillary toothrow (alveoli), 8.1.

Remarks.—The range of *T. b. internatus* seems to represent an extension of the *T. bottae* group northward along the east side of the Rocky Mountains. In general characters the present form closely approaches *T. b. pervagus* from which, however, it appears to be completely isolated by the high mountains inhabited by *T. fossor* to the westward. Specimens from northeastern New Mexico grade toward *T. b. ruidosae.*

Specimens examined.—Total number, 19, as follows:

COLORADO: Gardner, 2; Salida, 8.

NEW MEXICO: Folsom, 2; Oak Canyon (near Folsom), 2; Sierra Grande, 4; Trinchera Pass (mouth), Colfax County, 1.

Thomomys bottae howelli, subsp. nov.

Grand Junction Pocket Gopher

Type.—From Grand Junction, Mesa County, Colorado (altitude 4,600 feet). No 75684, ♀ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by A. H. Howell, November 7, 1895. Original number 493.

Distribution.—Known only from the type locality in the Grand River Valley, western Colorado.

General characters.—A rather large, pallid subspecies with a broad, flattened cranium. Similar to the palest specimens of *Thomomys bottae aureus* of the San Juan River Valley, southeastern Utah, in color, but under parts more thinly overlaid with buffy white, and cranial characters, especially the broad, flat braincase, distinctive. Approaching *Thomomys bottae osgoodi* of the Fremont River Valley, Utah, in color, but much larger and skull widely different.

Color.—*Type* (winter pelage): Upper parts in general between tilleul buff and pale olive buff (Ridgway, 1912), somewhat darkened on head by a mixture of cinnamon buff and brown; a few inconspicuous dusky-tipped hairs along median line of back; muzzle dusky; ears and postauricular spots deep, contrasting black; under parts thinly overlaid with buffy white, the hairs becoming pure white to roots on inguinal region; thighs pure white to roots all around; feet white; tail buffy whitish, slightly paler below than above.

Skull.—Similar in general to that of *T. b. aureus*, but braincase conspicuously broader and flatter; zygomata more widely spreading; nasals shorter; premaxillae more attenuate posteriorly; interparietal larger; audital bullae more rounded and fully inflated anteriorly; incisors short, as in *aureus*, but less strongly recurved. Compared with that of *T. b. osgoodi* the skull is much larger, with flatter braincase, shorter nasals, and posteriorly narrower premaxillae.

Measurements.—*Type:* Total length, 219 mm; tail, 71; hind foot, 29. *Skull* (type): Occipitonasal length, 36.8; zygomatic breadth, 23.7; breadth across squamosals (over mastoids), 20; height of braincase (over audital bullae), 12.1; interorbital constriction, 7.1; length of nasals, 10.8; maxillary toothrow (alveoli), 7.4.

Remarks.—*T. b. howelli* is based on a single specimen exhibiting characters which, in view of geographic isolation, seem to warrant subspecific recognition. It is more closely allied to *T. b. aureus* than to any other known form.

Thomomys bottae optabilis, subsp. nov.

Naturita Creek Valley Pocket Gopher

Type.—From Coventry, Naturita Creek Valley, Montrose County, Colorado (altitude 6,500 feet). No. 149962, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by Merritt Cary, July 31, 1907. Original number 1105.

Distribution.—Cultivated flats between Naturita Creek and the San Miguel River, southern Montrose County, Colorado; limits of range unknown.

General characters.—A large, cinnamon-buff subspecies. Size about as in the allied form, *Thomomys bottae aureus* of the San Juan River Valley, southeastern Utah, but color decidedly darker and cranial details, especially the more widely spreading zygomata, distinctive. Also similar in size to the

higher mountain form, *Thomomys bottae apache*, of the Jicarilla Indian Reservation, northwestern New Mexico, but color richer, more buffy, less dusky, and skull combining differential features.

Color.—Type (acquiring summer pelage): Upper parts near cinnamon buff (Ridgway, 1912), purest along sides, finely and evenly mixed with black on top of head and over back; under parts in general overlaid with pinkish buff; hairs on chin and middle of throat pure white to roots; forearms and thighs like under parts; muzzle and middle of face blackish; ears and postauricular areas black; feet white; tail buffy grayish above, somewhat lighter below to near tip which is silvery white all around.

Skull.—Large, but rather light in structure. Similar to that of *T. b. aureus*, but less robust; frontonasal region more depressed along median line; zygomata more slender, but more widely and squarely spreading, the antero-external angle weakly developed; nasals broader posteriorly, less wedge-shaped, the sides more nearly parallel; premaxillae narrower posteriorly; anterior nares higher, the nasals less flattened above; exposed portion of upper incisors longer, more procumbent. Very similar in general to that of *T. b. apache*, but lighter in structure; rostrum more slender; premaxillae narrower; frontal region narrower, more constricted; exposed portion of incisors longer.

Measurements.—Type: Total length, 250 mm; tail, 76; hind foot, 32. *Skull* (type): Occipitonasal length, 42.9; zygomatic breadth (at antero-external angle), 27.2; breadth across squamosals (over mastoids), 21.4; interorbital constriction, 6.4; length of nasals, 14.2; maxillary toothrow (alveoli), 8.2.

Remarks.—T. b. optabilis inhabits high valley areas, above the range of *T. b. aureus*, along the western side of the Rocky Mountains. In cranial characters it approaches *T. b. apache*, but is readily separated by richer coloration. It requires no close comparison with the pallid subspecies, *T. b. howelli*, of the Grand River Valley.

Specimens examined.—Two, from the type locality.

Thomomys bottae guadalupensis, subsp. nov.

Guadalupe Mountains Pocket Gopher

Type.—From McKittrick Canyon, Guadalupe Mountains, Texas (altitude 7,800 feet). No. 109225, ♂ adult, skin and skull, U.S. National Museum (Biological Survey collection); collected by Vernon Bailey, August 22, 1901. Original number 7821.

Distribution.—Guadalupe Mountains of southern New Mexico and western Texas.

General characters.—A light colored, medium-sized subspecies; pectoral mammae two pairs as usual in forms of *bottae;* very similar in general to *Thomomys bottae texensis* of the Davis Mountains, but color usually lighter; skull more massive, and differing in detail. Contrasting strongly in lighter color, compared with *Thomomys bottae ruidosae* of south central New Mexico, and cranial characters also distinctive.

Color.—Type (summer pelage): Upper parts light ochraceous buff (Ridgway, 1912), slightly darkened on top of head and over back by black-tipped hairs; under parts near pale ochraceous salmon, this tone extending upward over lower part of sides and including forearms and thighs; ears black,

invaded by buff anteriorly; black patches behind ears small; muzzle brownish; feet white; tail with a brownish tinge above, white below. Color varying in topotypes to between ochraceous buff and tawny above, and light ochraceous buff below.

Skull.—Similar to that of *T. b. texensis*, but broader and heavier; frontal region broader; nasals broader; premaxillae usually less extended beyond ends of nasals posteriorly; incisors shorter, decurvature about the same. Size of cranium about as in *T. b. ruidosae*, but rostrum and nasals shorter; frontal region broader; zygomata less strongly bowed outward posteriorly; incisors shorter, decurvature about the same.

Measurements.—Type: Total length, 218 mm; tail, 64; hind foot, 29. An adult female topotype: 200; 65; 29. *Skull* (type): Occipitonasal length, 37.1; zygomatic breadth, 23.7; breadth across squamosals (over mastoids), 19.0; interorbital constriction, 6.9; length of nasals, 12.3; maxillary toothrow (alveoli), 6.9.

Remarks.—T. b. guadalupensis is distinguished by pale coloration combined with cranial features unlike those of any of its geographic neighbors. The upper incisors are remarkably short in the older adults, especially males.

Specimens examined.—Total number, 6, as follows:

NEW MEXICO: Guadalupe Mountains (Dog Canyon, 6,800 feet), 2.

TEXAS: Guadalupe Mountains (McKittrick Canyon), 4.

Thomomys lachuguilla limitaris, subsp. nov.

Big Bend Pocket Gopher

Type.—From four miles west of Boquillas, Brewster County, Texas. No. 110339, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by Vernon Bailey, May 28, 1901. Original number 7659.

Distribution.—Northern side of the Rio Grande River Valley, from the "Big Bend" east at least to Devils River, and north to Castle Mountains, Texas.

General characters.—A small, pale buffy subspecies. Closely allied to *Thomomys lachuguilla lachuguilla* of the El Paso region, but still smaller, throat and chest white instead of buffy, and skull differing in detail; mammae, pectoral two pairs, inguinal two pairs, total eight as in *lachuguilla*. Similar in size and color to *Thomomys umbrinus perditus*, a geographic neighbor south of the Rio Grande, but pectoral mammae two pairs instead of one pair, and cranial characters different.

Color.—Type (unworn summer pelage): Upper parts near pinkish buff (Ridgway, 1912), the top of head and back somewhat darkened by black-tipped hairs; under parts overlaid with white; forearms, thighs, and feet white; muzzle brownish; ears black, except anterior margins which are buffy; black postauricular patches rather small; tail thinly clothed with whitish hairs above and below.

Skull.—Similar to that of *T. l. lachuguilla* in form, but still smaller, more delicate in structure; zygomata relatively more slender; premaxillae less extended beyond ends of nasals posteriorly; audital bullae relatively small-

er; dentition lighter; upper incisors decurved about as in *lachuguilla*. Compared with that of *T. u. perditus* the skull is similar in size and delicate structure, but the zygomata are less strongly bowed outward, the sides more nearly parallel; nasals less wedge-shaped, the posterior ends truncate instead of emarginate; lachrymals articulating less broadly with maxillae, as viewed from above; upper incisors more decurved, less procumbent

Measurements.—Type: Total length, 200 mm; tail, 67; hind foot, 27. An adult female topotype: 208; 66; 28. *Skull* (type): Occipitonasal length, 32.5; zygomatic breadth, 20.2; breadth across squamosals (over mastoids), 17; interorbital constriction, 7; length of nasals, 10.8; maxillary toothrow (alveoli), 6.8.

Remarks.—This new form is based upon a few specimens from several localities that exhibit too great a departure in cranial details for satisfactory reference to typical *lachuguilla*. It bears a superficial resemblance to *Thomomys umbrinus perditus*, but a summation of characters indicate specific distinction.

Specimens examined.—Total number, 9, all from Texas, as follows: Boquillas (type locality), 2; Castle Mountains, 1; Comstock, 3; Devils River, 13 miles below Juno, 1; Marathon, 1; Samuels, 19 miles west of Langtry, 1.

Thomomys lachuguilla confinalis, subsp. nov.

Rock Springs Pocket Gopher

Type.—From 35 miles east of Rock Springs, Texas (altitude 2,450 feet). No. 117571, ♂ subadult, skin and skull, U. S. National Museum (Biological Survey collection); collected by Vernon Bailey, July 11, 1902. Original number 7910.

Distribution.—Known only from the type locality in the upper part of the Nueces River Valley, central southern Texas.

General characters.—A small, cinnamon form, with weakly developed skull. Similar in general to *Thomomys lachuguilla limitaris*, but color richer, near cinnamon instead of pinkish buff, and skull more delicate in structure.

Color.—Type (acquiring fresh pelage): Head and anterior part of back near cinnamon (Ridgway, 1912), moderately mixed with black; rest of upper parts in worn pelage dull grayish; under parts white, the hairs white to roots on throat, under sides of forearms and inguinal region; forearms tinged with buff along outer sides; muzzle blackish; ears black, becoming buffy near anterior base; forefeet, thighs, and hind feet white; tail light brownish above, white below.

Skull.—Similar in size to that of *T. l. limitaris*, but more slender; zygomata narrower and tending to converge anteriorly, the sides less nearly parallel; premaxillae more prolonged beyond ends of nasals posteriorly; interparietal quadrate and nasals nearly truncate posteriorly as in *limitaris;* palate narrower; dentition lighter; incisors thinner and narrower; maxillary toothrow shorter.

Measurements.—Type: Total length, 200 mm; tail, 60; hind foot, 28. *Skull* (type): Occipitonasal length, 32.8, zygomatic breadth, 19.4; breadth across squamosals (over mastoids), 16.5; interorbital constrictions, 6.2; length of nasals, 10.8; maxillary toothrow (alveoli), 5.9.

Remarks.—*T. l. confinalis* is based upon a single specimen representing the extreme eastern limit of the known range of the genus in Texas. The combination of color and cranial details appear to be well beyond the range of individual variation in *T. l. limitaris*, the only form with which it requires close comparison.

Thomomys pectoralis, sp. nov.

Carlsbad Pocket Gopher

Type.—From vicinity of Carlsbad Cave, Carlsbad Cave National Monument, Eddy County, New Mexico. No. 244372, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by Vernon Bailey, March 17, 1924. Original number 10222.

Distribution.—Known only from the type locality in the Pecos River Valley, southeastern New Mexico.

General characters.—A small, pinkish buffy species, closely resembling *Thomomys lachuguilla* of the Rio Grande Valley region near El Paso, Texas, but smaller; pectoral mammae apparently limited to a single pair, instead of two pairs as in *lachuguilla;* skull smaller, less massive, and differing in detail. Size much smaller and color paler than in *Thomomys bottae guadalupensis* of the neighboring Guadalupe Mountains; pectoral mammae apparently one pair, instead of two pairs as in *guadalupensis;* cranial characters quite different.

Color.—Type: Upper parts near pinkish buff (Ridgway, 1912), slightly darkened on head and over dorsum by admixture of black-tipped hairs; under parts overlaid with pinkish buff, extending upward to include outer sides of forearms and thighs; muzzle blackish; ears encircled by black; feet white; tail brownish above, white below.

Skull.—Similar in general to that of *T. lachuguilla*, but smaller, less massive; rostrum narrower; zygomata more slender; interparietal more triangular; premaxillae less extended beyond ends of nasals posteriorly; bullae smaller; upper incisors thinner and slightly more procumbent. Compared with that of *T. b. guadelupensis* the skull is smaller, less angular, and lighter in structure; interparietal more triangular; bullae more smoothly rounded; dentition similar.

Measurements.—Type: Total length, 186 mm; tail, 48; hind foot, 25. An adult female topotype: 188; 55; 26. *Skull* (type): Occipitonasal length, 34; zygomatic breadth, 21.8; breadth across squamosals (over mastoids), 18; interorbital constriction, 6.7; length of nasals, 11.3; maxillary toothrow (alveoli), 6.8.

Remarks.—This little pocket gopher presents a departure from the neighboring forms in the apparent reduction of the pectoral mammae to a single pair. At least I have been able to find only one pair in a topotype in which the mammae had been functional and are clearly visible. In this character the present form agrees with *Thomomys umbrinus* of Mexico, but differs in important cranial features and requires no close comparison.

Specimens examined.—Three, all from the type locality.

ZOOLOGY.—*Chinese spiders of the families Agelenidae, Pisauridae, and Sparassidae.*[1] IRVING FOX (Communicated by C. F. W. MUESEBECK.)

In the course of identification of Chinese spiders which have accumulated in the United States National Museum, several new species were found. These new species, together with others noted below, were collected by Dr. D. C. Graham chiefly in Szechwan Province, China, during the years 1923, to 1930.

I wish to thank the authorities of the United States National Museum, especially Dr. E. A. Chapin, for placing these collections in my hands, and for their helpfulness and courtesy while this work was in progress.

Family AGELENIDAE

Agelena difficilis, n. sp. Fig. 5

Male.—Total length, 9.40 mm. Carapace, 4.85 mm long, 3.56 mm wide. Abdomen, 4.95 mm long, 3.07 mm wide.

Carapace brown with a lighter median band which widens from the eye rows backward for about a fourth of the length of the carapace; it then abruptly narrows to a point and ends at the longitudinal furrow. Sides of the carapace with wide submarginal white stripes, and much narrower dark brown marginal ones. Clypeus reddish brown, chelicerae lighter, clothed with long white hairs. Sternum, labium, and endites reddish, darker than the coxae. Legs uniform light yellow, clothed with white hairs. Dorsum and sides of the abdomen dark brown, venter with a broad brown stripe extending from the epigastric furrow to the spinnerets. Spinnerets light brown, the last pair about twice as long as the first pair. The distal joint of the last pair of spinnerets about twice the length of the basal.

Eyes characteristically in two strongly procurved rows. Anterior median eyes closer to the laterals than to each other and slightly larger than the laterals. Eyes of the second row equal in size, equidistant, spaced about a diameter apart. The lateral eyes of both rows subequal and subcontiguous. Median ocular quadrangle about as long as wide, slightly wider in front than behind (15/14), the posterior median eyes about five-sixths the size of the anterior median. Clypeus equal in height to one and one-third times the diameter of an anterior median eye. Chelicerae with five teeth on the lower margin and three on the upper.

Tibia I armed below with a submedian and a basal pair of spines; tibiae II, III, IV, with a single submedian and a single basal spine. Tibia and patella I, 5.94 mm long. Tibia and patella IV, 5.84 mm long. Patella of the palpus about five-sevenths the length of the tibia, both together about one-half the length of the femur. Distal edge of the patella with two sharp black spurs. Tibia hook-like inwardly.

Type locality.—China: Male holotype and 2 male paratypes from Suifu, Szechwan Province, October, 1930. U.S.N.M. Cat. No. 1149.

This spider resembles *Agelena japonica* Karsch in the possession of an embolus which is robust and projects forward. The embolus differs from

[1] Received November 11, 1935.

that of the latter species, however, in being spiral-shaped basally and forming a distinct coil distally, as is shown in Figure 5.

Agelena injuria, n. sp. Fig. 3

Male.—Total length, 11.78 mm. Carapace, 5.74 mm long, 4.85 mm wide. Abdomen, 6.14 mm long, 3.17 mm wide.

The carapace of this specimen is damaged, and therefore somewhat distorted. It is reddish brown with a faint lighter median band that is as wide as the eye rows anteriorly, but converges posteriorly to a narrower portion which disappears in the pronounced longitudinal groove. Sides of the carapace with wide submarginal bands of whitish hairs. Clypeus dark, chelicerae lighter, sparsely provided with white hairs. Sternum, labium, and endites dark red; labium and endites with much lighter edges. Legs light reddish or orange, patella, and the proximal ends of the femur and tibia darker. Dorsum of the abdomen dark brown, tinged with red at the base. Sides of the abdomen brown, the venter much paler, furnished with whitish stripes, one on each side, which more or less outline it. Spinnerets light brown in color, with the last pair about twice the length of the first pair. Distal joint of the last pair of spinnerets much longer than the basal (14/6).

Eyes characteristically in two strongly procurved rows. Eyes of the first row about the same size, the medians closer to the laterals than to each other. Eyes of the second row with the medians smaller than the laterals, equidistant, about one diameter of a posterior lateral eye apart. The lateral eyes of both rows subequal and subcontiguous. Median ocular quadrangle slightly longer than wide (19/17), wider in front than behind (17/16), the posterior median eyes about five-sevenths as large as the anterior median eyes. Clypeus slightly more than the diameter of an anterior median eye in height. The metatarsi of the posterior legs bear numerous long hairs. Tibia and patella IV, 8.32 mm long.

Patella of the palpus less than twice as long as the tibia, both together about three-fifths the length of the femur. Patella provided with a black lateral spur extending outward; tibia with a ventral distal process that does not touch the posterior border of the bulb.

Type locality.—China: Male holotype from Yao-Gi, Mupin, Szechwan Province, 8,000 feet, July 14, 1929; male paratype from Tatsientu, July 20, 1923. *Type:* U.S.N.M. Cat. No. 1150.

This spider bears considerable resemblance in its general structure to *Agelena labyrinthica* (L), but is immediately distinguishable from that species by the structure of the palpal organ which has an embolus that is distinct and separated from the process of the bulb.

Agelena opulenta L. Koch

Agelena opulenta L. Koch. Verh. Zool.—Bot. Gesell. Wien 27: 757, pl. XV, fig. 20. 1877.

Records.—China: Yunnan Border, 6,000 ft., October, 1928, female; Szechwan Province, Suifu, 1,000 ft., October, 1930, two females.

Coras luctuosus (L. Koch)

Coelotes luctuosus L. Koch. Verh. Zool.—Bot. Gesell. Wien 27: 752, pl. XV, figs. 14, 16, 1877.

Record.—China: Szechwan Province, Suifu, 1,000 ft., November 17, 1930, female.

Family PISAURIDAE

Dolomedęs chinesus duoformus, n. subsp. Fig. 2

Female.—Total length, 17.33 mm. Carapace, 7.92 mm long, 6.44 mm wide. Abdomen, 9.20 mm long, 5.15 mm wide.

Carapace yellowish brown, lighter behind the eyes, darker about the longitudinal groove. Sides of the carapace presenting a mottled appearance having irregular lighter spots and streaks. Posterior lateral eyes situated on black spots. Clypeus with two dark lines that converge at the anterior median eyes; each of these lines extend down a chelicera as a median stripe. Labium and endites reddish yellow, sternum with a central light leaf-like design. Legs with coxae, femora, and patellae blackish mottled with yellow beneath, but reddish above as are the other joints. Abdomen brown, darker than the carapace; venter reddish, with indications of a darker median stripe that extends from the epigynum to the spinnerets.

First row of eyes longer than the second (30/26), recurved, the median eyes closer to the laterals than to each other and much larger (7/4). Second row narrower than the third (26/52). The eyes about their diameter apart, each eye seven-ninths its diameter from an anterior lateral eye. Clypeus equal in height to the length of the area formed by the first and second eye rows.

Legs moderately long, anterior tibiae with 2–2–2–2 spines below, the last pair apical. Tibia and patella I, 12.18 mm long. Tibia and patella IV, 11.88 mm long.

Type locality.—China: Female holotype from between Suifu and Yachow, Szechwan Province, 1,000 ft., June 5, 1929; two female paratypes from Yachow, Szechwan Province, 2,000 ft., July, 1928; one female paratype from Ningyuen Fu, Szechwan Province, 6,200 ft., July 31, 1928. *Type:* U.S.N.M. Cat. No. 1151.

This subspecies differs from *D. chinesus* Chamberlin in being much smaller in size, and in lacking a dorsal dark band outlined by white stripes. The epigyna, although apparently identical, differ slightly in that the median piece of *D. chinesus duoformus*, new subspecies is wider than that of *D. chinesus* Chamberlin, although the latter spider is as a whole larger in size.

Dolomedes insurgens Chamberlin

Dolomedes insurgens Chamberlin. Proc. United States Nat. Mus. 63 (art. 13) 25–26, pl. 6, fig. 41. 1924.

Records.—China: Szechwan Province, Yachow, May 1928; between Suifu and Yachow, 1000 ft., June, 5 1929, two males; Mt. Omei July, 1921, male; Suifu 2,000 ft., April 18, 1926, male.

Pisaura lama Bösenberg and Strand

Pisaura lama Bösenberg and Strand. Abh. Senckenb. Naturf. Gesell. 30: 306-307, pl. 13, fig. 340. 1906.

Record.—China: Szechwan Province, Yao-Gi, near Mupin, 8,000 ft., July 14, 1929, female.

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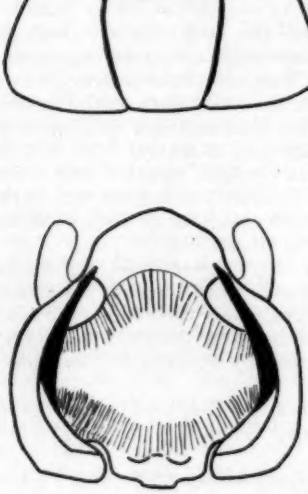

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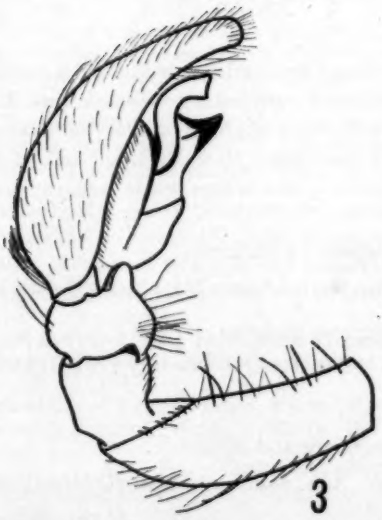

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Fig. 1.—*Heteropoda amphora*, n. sp., epigynum. Fig. 2.—*Dolomedes chinensus duoformus*, n. subsp., epigynum. Fig. 3.—*Agelena injuria*, n. sp., palpus. Fig. 4.—*Heteropoda grahami*, n. sp., epigynum. Fig. 5.—*Agelena difficilis*, n. sp., palpus. Fig. 6.—*Heteropoda virgata*, n. sp., palpus.

Family SPARASSIDAE

Heteropoda amphora, n. sp. Fig. 1

Female.—Total length, 18 mm. Carapace, 6.93 mm long, 6.43 mm wide. Abdomen, 11.00 mm long.

Carapace reddish yellow, discolored by deeper red bars or short stripes, and dark, sparsely distributed hairs. Spaces between the eyes red. Clypeus light yellow, with a reddish brown edge. Chelicerae reddish brown with darker longitudinal stripes. Coxae, sternum, and endites clear yellow, labium somewhat darker and edged with brown. Legs and palpi yellowish, femora punctuate with red beneath, bearing three large red spots, each at the base of a spine, on the prolateral surfaces; patellae, tibiae, and metatarsi darker than the femora above. Dorsum of the abdomen deep red, with indications of a lighter mark anteriorly. Venter much lighter, abruptly differentiated from the sides; it bears some indication of a darker median stripe which extends from below the genital fold nearly to the spinnerets.

First row of eyes slightly procurved, two-thirds as wide as the second row, which is slightly recurved, with the laterals on protuberances. Anterior median eyes more than a diameter apart, three-fifths of a diameter from the anterior lateral, and much smaller than these (6/13). Posterior median eyes separated from each other by more than a diameter, from the posterior lateral by almost two diameters and also much smaller than the latter (2/3). Median ocular quadrangle longer than wide (15/14), narrower in front than behind (9/14). Clypeus higher than the diameter of an anterior lateral eye (15/12). Chelicerae with four teeth on the lower margin, of which the one furtherest from the claw is the least robust, and three teeth on the upper margin, of which the middle one is the most robust. Labium slightly wider than long, and much shorter than the endites (22/55).

Posterior tibiae and metatarsi with 2–2–2 spines below, the last pair apical, metatarsi with 1–1 spines on the lateral surfaces. Anterior tibiae with 2–2–2–2 spines below, the last pair apical, anterior metatarsi also with 1–1 spines on the lateral surfaces. Trochanters notched. Epigynum chitinous, wider than long, flattened below, with the median piece oval, vase-like being constricted anteriorly.

Type locality.—China: Female holotype from between Suifu, and Yachow Szechwan Province, 1,000 feet, June 5, 1929. *Type*: U.S.N.M. Cat. No. 1152.

This spider resembles the Ceylonese species, *H. Kandiana* Pocock in having an epigynum whose median piece is linguiform, and a pale clypeus which is more or less crescentic in shape. It differs in being smaller by six millimeters, and in possessing an anterior row of eyes which is slightly procurved rather than strongly so. These similarities and differences are derived not from an examination of specimens of *H. Kandiana* Pocock themselves, but from a study of Pocock's brief descriptions.[2]

Heteropoda grahami, n. sp. Fig. 4

Female.—Total length, 12.00 mm. Carapace, 4.55 mm long, 4.45 mm wide. Abdomen, 7.52 mm long, 4.95 mm wide.

[2] Jour. Bombay Nat. Hist. Soc. 12: 752. 1899; *The fauna of British India*, Arachnida, p. 261, 1900.

Carapace yellowish with red markings at the pars cephalica, and a darker median line which extends from between the posterior median eyes to the rear slope. Sides of the carapace with reddish streaks, and dark margins. Eyes on a red background. Clypeus light yellow; chelicerae also yellow, each with short reddish bars followed by several reddish spots. Sternum yellow with four dark marks on each side, and a larger diamond-shaped central one. Labium and endites yellowish. Legs yellow beneath, all the joints except the metatarsi and tarsi richly provided with small red spots. Femora with three large red spots on the prolateral surfaces. Dorsum of the abdomen having a yellow ground densely provided with irregular red markings, which become more dilute at the sides and venter.

The eyes in two slightly recurved rows, with the first row three-fourths as wide as the second. Anterior median eyes about two-thirds of a diameter apart, one-third of a diameter from the anterior lateral, and smaller than these (3/4). Posterior median eyes about a diameter and a third apart, about two diameters from the posterior lateral, and smaller than these (6/7). Median ocular quadrangle slightly longer than wide (20/19), narrower in front than behind (15/19). Clypeus higher than the diameter of an anterior lateral eye (5/4). Chelicerae with four teeth on the lower margin, of which the one furthest from the claw is the least robust, and two teeth on the upper margin with strong indication of a third one. Labium slightly wider than long, and much shorter than the endites (15/35).

Anterior tibiae with 2–2–2–2 spines below, the last pair apical, 1 submedian spine on each lateral surface, and 1–1 above, the first spine basal; anterior metatarsi with 2–2 spines below, 1–1 on the lateral surfaces and one above. Tibia of fourth leg with 2–2–2 spines below, the last pair apical, 1–1 on the lateral surfaces, and 1 above; metatarsus of fourth leg with 1–1–1 spines below, the last apical and reduced, 1–1–2 on the lateral surfaces, the last pair apical and reduced, none above. The third legs are like the fourth except that they lack the reduced apical apines on the metatarsi. Legs 2134. Trochanters notched.

TABLE 1.—LEG MEASUREMENTS IN MILLIMETERS

	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	6.63	2.48	6.63	6.04	2.08	23.86
II	7.23	2.67	6.73	6.34	2.18	25.15
III	5.45	2.08	5.05	4.55	1.58	18.71
IV	6.44	2.18	5.15	4.74	1.98	20.49

Epigynum not chitinous in front, and open; behind expanded into two projections, which are contiguous at the bases, but widely separated distally.

Type locality.—China: Female holotype from Ningyuen Fu, Szechwan Province, July 31, 1928; immature female paratype from Yachow district, Szechwan Province, 1,800 ft., May, 1928. *Type:* U.S.N.M. Cat. No. 1153.

This spider seems to be most closely allied to the Japanese *Heteropoda aulicus* L. Koch, but differs from that species in the relationship of the eyes and in the structure of the epigynum.

Heteropoda virgata, n. sp. Fig. 6

Male.—Total length, 10.49 mm. Carapace, 5.45 mm long, 4.75 mm wide. Abdomen, 4.95 mm long, 2.97 mm wide.

Carapace clear reddish brown with darker streaks at the sides. Sides of the carapace, clypeus, and chelicerae lighter. Sternum, labium, and endites orange. Legs clear yellow. Dorsum of the abdomen reddish brown, sides lighter. Venter pale, outlined by a dark line on each side which extends from the genital fold almost to the spinnerets.

First row of eyes straight or slightly procurved, three-fourths as wide as the second row, which is slightly recurved, with the laterals on protuberances. Eyes of the first row about equidistant, the median smaller than the lateral (3/4). Posterior median eyes separated from each other by about a diameter, from the posterior lateral by more than a diameter (11/7), and smaller than these (6/7). Median ocular quadrangle longer than wide (18/21), narrower in front than behind (15/18). Clypeus about as high as the diameter of an anterior lateral eye. Chelicerae with four teeth on the lower margin, of which the one furthest from the claw is the least robust, and three teeth on the upper margin, of which the middle one is the most robust. Labium wider than long (18/15), and much shorter than the endites (15/38).

Anterior tibiae with 2–2–2–2 spines below, the last pair apical, 1 spine laterad, 1–1 above, the first spine basal; anterior metatarsi with 2–2 spines below, 1–1 laterad. Tibia of the fourth leg with 2–2–2 spines below, the last pair apical, 1–1 laterad, 1 above; metatarsus of the fourth leg with 1–1–1 spines below, 1–1–2 laterad. The third leg like the fourth except that it lacks the reduced distal spines on the metatarsus. Legs 2143, trochanters strongly notched.

TABLE 2.—LEG MEASUREMENTS IN MILLIMETERS

	Tr.&Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	6.83	2.57	6.24	6.92	2.48	25.04
II	7.72	2.67	6.83	7.03	2.57	26.82
III	6.53	2.18	5.34	6.14	1.88	22.07
IV	6.72	2.28	5.54	6.83	2.13	23.55

The tibia of the palpus bears a hooked projection which is almost as long as the tibia itself.

Type locality.—China: Male holotype from between Suifu and Yachow, Szechwan Province, 1,000 ft., June, 1929. *Type:* U.S.N.M. Cat. No. 1154.

The unusually small size and glabrous condition of this spider together with the structure of the palpus, which is shown in Figure 6, will immediately distinguish it from other oriental species.

Heteropoda forcipata (Karsch)

Sarotes forcipatus Karsch Berliner Entom. Zeitschrift **25**: 38. 1881.

Records.—China: Szechwan Province, near Mupin, 3,000 ft. July 1, 1929,

female; Suifu, 1922, female; Washan, 2,000 ft., July 18, 1925, female; Ningyuen Fu, July 31, 1928, female.

Heteropoda venatoria (Linnaeus)

Aranea venatoria Linnaeus Syst. Nat., 12th ed., p. 1035. 1767.

Records.—China: Szechwan Province, Washan, 2,000 ft., July 18, 1925, female; Suifu, 1922, female; April, 1924, female; April, 1928, two females; March 15, 1929, female.

ICHTHYOLOGY.—*Description of a new flatfish, with notes on related species.*[1] ISAAC GINSBURG, Bureau of Fisheries. (Communicated by WALDO L. SCHMITT.)

An extensive study of the American species of flatfishes belonging to the genus *Paralichthys* and the closely related genera *Hippoglossina* and *Pseudorhombus*, was carried out by me recently. Since the publication of the final report is likely to be delayed for some time, some of the more interesting results of that study, as well as a description of a new species, are published here separately.

Certain errors in the systematics of the species under consideration have been repeated for years and have acquired the weight of tradition. Nevertheless, the morphological facts compel me to break away from tradition. In a recent valuable book on the systematics of the flatfishes by Norman,[2] which is bound to be used as a standard book of reference by students of flatfishes in the years to come, a number of these errors are included. The most important of such current errors are here corrected.

The three genera under consideration were incompletely separated heretofore, and as a consequence some of the species were referred to genera to which they do not belong. The only substantial character which has been used for distinguishing *Pseudorhombus* from *Paralichthys* and *Hippoglossina* was the presence or absence, or the relative development, of the anterior branch of the lateral line. This character was used by previous authors and its use is continued by Norman.

However, this character only incompletely separates the groups of species. In the smaller Indo-Pacific species, which belong to *Pseudorhombus*, this accessory branch is *generally* better developed, reaching the dorsal profile, while in the American species it is usually not as

[1] Published by permission of the U. S. Commissioner of Fisheries. Received December 30, 1935.

[2] NORMAN, J. R. *A systematic monograph of the flatfishes (Heterosomata). Vol. 1. Psettodidae, Bothidae, Pleuronectidae.* British Museum, London, 1934.

well developed; but this is not always true. In some species of *Pseudorhombus* the accessory branch is not better developed than in most American species; and in *californicus*, the genotype of *Paralichthys*, it is often well developed, reaching or nearly reaching the dorsal profile. Although these facts are shown in part by the outline figures published by Norman, he continues the use of this character in his key which is thus not entirely in accord with his own figures. As a matter of fact, the use of this character as the basis for the major division of the three genera leads to false conclusions. During my studies it was determined that the presence or absence of accessory scales constitutes a valuable character for the major division of the species into natural groups. Although this character was neglected heretofore, its use leads to a more natural classification of the species.

KEY TO THE GENERA

a. Accessory scales absent.
  b. Eyeball and orbit very large to moderately large, interorbital reduced to a mere ridge and origin of dorsal more or less behind anterior margin of eye; the three characters always occurring together. Anterior accessory branch of lateral line often rather poorly developed..... .....*Hippoglossina* Steindachner
  bb. Eyeball and orbit usually small or moderate, sometimes moderately large; interorbital usually wider than a mere ridge, sometimes reduced to a narrow ridge; origin of dorsal usually in front of anterior margin of eye, sometimes behind its anterior margin; sometimes approaching *Hippoglossina* in one or another of these characters, but the three usually not occurring together. Accessory branch of lateral line usually but not always reaching dorsal profile.....*Pseudorhombus* Bleeker
aa. Accessory scales always present, except in small specimens, their appearance with respect to size differing with the species..... .....*Paralichthys* Girard

By the use of the above synopsis *Paralichthys* may in practice be distinguished satisfactorily, except for the smaller specimens; but much remains to be desired with respect to the separation of *Hippoglossina* and *Pseudorhombus*. The characters given in the key are the best known at present for separating those two genera, and judging solely by these characters, the best course would seem to be to unite them. However, each one of the two groups of contained species has a distinctive physiognomy and it seems highly probable that further study will reveal more satisfactory characters for separating them. Current usage is therefore continued and the two genera

are recognized as distinct for the time being. No matter how limited the synopsis may be for use in practice, it evidently groups the species in accordance with their true natural relationship.

Hippoglossina mystacium, n. sp. Fig. 1

Description.—On eyed side scales ctenoid on body; mostly cycloid on head, but many weakly ctenoid scales present. On blind side, ctenoid scales present on posterior part of body, the ctenoid scales extending on midline to a distance behind arch about equal to 1/2 of its chord; scales on head and on body anteriorly cycloid. Scales in 52 rows over straight part of lateral line to end of hypural; 28 perforate scales in arch; 26 rows in a chord subtending the arch. Three cycloid, embedded scales on maxillary. Accessory scales absent. Gill rakers, 3 comparatively long ones on upper limb, with

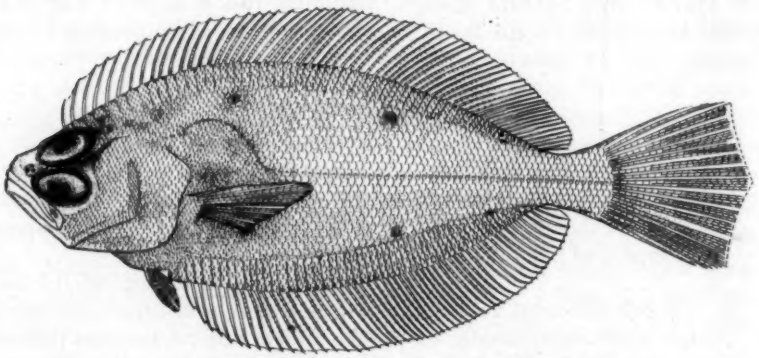

Fig. 1.—*Hippoglossina mystacium*, n. sp. Length of specimen 18.3 cm. Drawn from the type by Louella E. Cable.

2 widely spaced and very small ones above; 12 on lower limb (same on both sides). Anal rays 55; dorsal rays 66; pectoral rays 11 on eyed side, 10 on blind side. Origin of dorsal nearly over middle of eye. Eye notably large; interorbital a mere ridge. Anterior teeth but slightly enlarged. Maxillary extending to a vertical through posterior margin of pupil, conspicuously narrow posteriorly. Sinistral.

Color nearly faded, traces of 6 spots in 2 lengthwise rows present, like in the other species of the genus, somewhat nearer to upper and lower profiles than to straight part of lateral line, every spot in either row placed on a transverse line with its fellow in the other row; first pair of spots on a transverse line through about middle of arch in lateral line, second pair on a vertical somewhat nearer to head than to base of caudal, third pair not far from ends of dorsal and anal fins; traces of smaller spots on caudal peduncle, one each near upper and lower posterior angles, at base of caudal rays, these two spots being continued to a slight extent on blind side.

Measurements of type.—Total length 183 mm. Standard length 146.5 mm. Greatest depth 39.8, least depth of caudal peduncle 9.5, head 30.7, length of maxillary 13.6, greatest width of maxillary 3, orbit 10.4, eyeball 8.5, snout (to margin of upper orbit) 6.5, left pectoral 17.9, right pectoral 13.1,

left ventral 9.1, right ventral 8.8, caudal 24.9, and straight part of lateral line 57.1% of standard length. Length of chord subtending arch in lateral line 3.6 times in straight part; length of a vertical from chord to apex of arch 3.2 times in arch.

Holotype.—U.S.N.M. 77393, near Taitao Peninsula, Chile; Albatross Station 2787; lat. 46°47′30″ S., long. 75°15′ W.; 61 fath.; Feb. 9, 1888.

Comparison.—The nearest relatives of this species are *Hippoglossina stomata* Eigenmann and Eigenmann, *H. bollmani* Gilbert and *H. macrops* Steindachner. The specimen described was directly compared with specimens of the former two species, including their types; but for its comparison with *macrops*, I had to rely on the original account. It is most closely related to *stomata*, differing in having a shorter and narrower maxillary, and a shorter head. It further differs in that the maxillary is almost bare of scales, while that of *stomata* has a small patch of ctenoid scales. The present species is more remotely related to *bollmani*. It differs strikingly from *bollmani* in having more numerous gill rakers, and the anal rays are also more numerous. The number of scales and dorsal rays falls near the upper end, but outside the frequency distribution of that of *bollmani*. The ctenoid scales on the blind side extend more forward in *bollmani*. The body is deeper than in *bollmani;* but the two species approach closely in the length and width of the maxillary and the length of the head. As compared with the description of *macrops*, the present species has a shorter head, a more slender body and the ctenoid scales on the blind side extend more forward.

Hippoglossina oblonga (Mitchill)

This species from the east coast, which is common enough to enter the commercial catch, although its market possibilities are limited by its comparatively small size, has been placed universally, except by the early authors, in *Paralichthys*. However, unlike all species of *Paralichthys* it lacks accessory scales. In this it agrees with the species of *Hippoglossina*. Also, it always has some ctenoid scales on the blind side, a character normally present in most species of *Hippoglossina* but not in those of *Paralichthys*, except to some slight extent in infrequent individual variants. Furthermore, this species has a very narrow interorbital, a comparatively large eye and relatively small teeth, nearly agreeing with the species of *Hippoglossina* in these respects and unlike all species of *Paralichthys*. It is evident that this species is congeneric with the other species of *Hippoglossina*.

H. oblonga is evidently most nearly related to *Lioglossina tetrophthalmus* Gilbert from the west coast. After placing it where it properly belongs in the system, the boundary hitherto drawn between the genera *Lioglossina* and *Hippoglossina* largely breaks down, although they may be recognized as subgenera.

Pseudorhombus isosceles (Jordan)

This species likewise lacks accessory scales and has ctenoid scales on the blind side, and consequently must be removed from *Paralichthys*. It fairly agrees with the other species of *Pseudorhombus* and is the only known American representative of that genus. This species, the genotype of *Tarphops*, and four other Indo-Pacific species have ctenoid scales on the blind side. Judging by the morphology of the species of these three closely related genera, this character forms a more adequate and natural basis for separation than the number of scales. It would seem, therefore, desirable on grounds of morphology to rearrange the species of *Tarphops* and *Pseudo-*

rhombus and place them in two subgenera based on the presence or absence of ctenoid scales on the blind side. In that case, *isosceles* will fall in the subgenus *Tarphops*.

Paralichthys triocellatus Miranda Ribeiro, judging by the original account, is probably a synonym of *isosceles*. Four specimens of a flounder obtained at Cape Frio, Brazil, by the *Terra Nova* and recorded by Regan as *Paralichthys oblongus* are described and figured by Norman (op. cit., p. 80), and referred to *triocellatus*. Norman describes these specimens as having cycloid scales on the blind side. If *triocellatus* is in fact a synonym of *isosceles*, the four specimens forming the basis of Norman's account must represent an unnamed species. Even if *triocellatus* is distinct from *isosceles*, Norman's specimens evidently have fewer scales than Miranda Ribeiro's fish and they probably represent a new species anyway.

Paralichthys patagonicus Jordan and Goss

This species is placed by Norman in the synonymy of *vorax* (his *brasiliensis*). However, it has ctenoid scales on the eyed side and is entirely distinct from that species. *P. bicyclophorus* Miranda Ribeiro which Norman recognizes, is possibly a synonym of *patagonicus*. At least, the original account of *bicyclophorus* fails to show how it differs from this species.

Paralichthys brasiliensis (Ranzani)

Something may be said about the nomenclature of this and another species. Norman resurrects a name out of the synonymy and designates this species as *P. orbignyana* (Valenciennes), and uses the name of *brasiliensis* for an entirely different species, although he apparently did not examine the types on which either one of those two names were based. This shifting about of the names of species, one of them well established, seems unfortunate. This is a common species on the coast of Brazil which has been described and recorded a number of times by American authors to whom it was known for more than half a century under the name of *brasiliensis*. There are those biologists who claim that a well established name should be retained regardless of priority and there are some cogent arguments which may be advanced in favor of that contention. Without discussing the pros and cons of this proposition, I think that it will be generally admitted that, at least, a well established name is not to be changed unless good and sufficient reasons are advanced for the change. In the present case the only way of definitely determining the question is by a reexamination of the types of both, *brasiliensis* and *orbignyana*, since the original accounts are not sufficient to identify the particular species. Pending such study I continue the use of the well established name *brasiliensis* for this species. Judging by the material in the U. S. National Museum and that recorded by Norman in the British Museum, the present species is much more common than the following. Considering probabilities alone, therefore, the chances are much greater that Ranzani had specimens of the present species.

Paralichthys vorax (Günther)

American writers have generally placed the name *vorax* in the synonymy of their *brasiliensis;* while Norman who designates the *brasiliensis* of American authors as *orbignyana*, describes this species under the name of *brasiliensis*. We thus have a nice, and possibly unnecessary confusion of names. Norman, who studied the types of *vorax*, correctly distinguishes this species from the *brasiliensis* of American authors.

It is remarkable that in the structural characters which I studied in detail, such as the number of gill rakers, fin rays, scales and proportional measurements, this species agrees or very nearly agrees with *albigutta* from the east coast of the United States, although the geographic ranges of the two species are widely discontinuous. The only substantial difference is found in the color, *vorax* lacking the ocellated spots characteristic of *albigutta*.

There is only one specimen of this species in the U. S. National Museum. Norman records only two specimens, the types, in the British Museum. That author also lists with a query one large, stuffed specimen from Fort Famine, Magellan Strait. This is apparently the same specimen which Günther described as *Pseudorhombus dentatus*, stating that the scales are "minutely ciliated." The presence or absence of ctenoid scales in large specimens is always a good specific character in *Paralichthys*. This specimen, therefore, represents either *patagonicus* or an unnamed species.

Paralichthys lethostigma Jordan and Gilbert

Norman evidently did not well separate his material of *Paralichthys* from the east coast of the United States. The specimen from Beaufort, North Carolina, which he records under this species is an unusually slender example of *albigutta*. The specimen which Norman lists from Tobago can hardly be a *lethostigma* considering the comparatively limited geographical distribution of the species of *Paralichthys*. It may likely prove to be an example of *P. tropicus* Ginsburg which is very near in its structural characters to *lethostigma*. The counts of the dorsal and anal rays given by Norman for *lethostigma* range too low. This is evidently due to his inclusion of some *albigutta* material in his account. The frequency distributions of these counts are very nearly the same in *dentatus* and *lethostigma*.

The species of *Paralichthys* are not easy to distinguish. Nevertheless, if frequency distribution tables of the more important specific characters are prepared, and the several characters of any given specimen are compared with such tables, it becomes a relatively easy matter to refer with assurance individual fish to their proper species. Such tables of the scale, gill raker, and fin ray counts, and comparative tables of proportional measurements are included in my manuscript.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE ACADEMY

38TH ANNUAL MEETING

The 38th Annual Meeting of the Washington Academy of Sciences was held in the Assembly Hall of the Cosmos Club, January 16, 1936, with 45 members present. President McCoy called the meeting to order at 9:05 P.M.

The minutes of the 37th Annual Meeting were read and approved. The Corresponding Secretary, Dr. Paul E. Howe, submitted the following report on the membership and activities of the Academy:

Membership: During the year 1935, 18 persons were elected to regular membership, 15 of whom had accepted and qualified for membership before the end of the year. One was elected to honorary membership: Dr. Jules Schokalsky, Leningrad, U.S.S.R., in recognition of his distinguished contributions to physical geography, oceanography and meteorology.

Sixteen resignations were accepted, of which 11 were resident and 5 non-resident members. The Academy lost by death 14. The net loss in membership was therefore 15 or 2.7 per cent.

The members of the Academy stood in respect as the Secretary read the names of those lost by death.

Members:

William H. Burr, New York, New York, December 13, 1934.
Joseph H. Bryan, Washington, D. C., February 3, 1935.
Edward S. Dana, New Haven, Connecticut, June 16, 1935.
Leon Dominian, Montevideo, Uruguay.
Marion Dorset, Washington, D. C., June 14, 1935.
Ernst G. Fischer, Washington, D. C., September 22, 1935.
Daniel R. Harper, Washington, D. C.
Albert S. Hitchcock, Washington, D. C., December 16, 1935.
Walter Hough, Washington, D. C., September 20, 1935.
A. Bruce Macallum, London, Ontario, Canada, April 4, 1934.
David K. Shute, Washington, D. C., October 21, 1935.
(Charles) David White, Washington, D. C., February 6, 1935.

Patron:

Henry C. Perkins, Washington, D. C.

Honorary Member:

Johannes Schmidt, Copenhagen, Denmark.

On January 1, 1936, the membership consisted of 14 honorary members, 3 patrons, and 522 members, one of whom was a life member. The total membership was 539, of whom 387 reside in or near the District of Columbia, 131 in other parts of the United States, and 21 in foreign countries.

The numerical index which the Secretary in previous reports has called the "index of rate of loss of interest" in the organization on the part of its

members as measured by the number per year per hundred who resign or are dropped, has the value of 2.7 per cent for 1935.

The Board of Managers held five meetings with an average attendance of 12. The 29th edition of the Red Book was published during the year.

The Academy was represented by Dr. A. S. HITCHCOCK at the International Botanical Congress held in Amsterdam in September, 1935.

The Recording Secretary presented the following report:

The 38th year of the Academy began with the 262nd meeting and ended with the 268th meeting. Of these seven meetings, two were joint meetings, one with the Medical Society, one with the Philosophical Society. All were held in the Assembly Hall of the Cosmos Club.

The 262nd meeting was held on Friday, February 15, 1935, with about 70 persons present. President MCCOY introduced the speaker, retiring president L. B. TUCKERMAN, who addressed the Academy upon *Fiction in measurement.*

The 263rd meeting was held March 8, 1935, with about 40 persons present. Mr. W. M. CORSE presided and introduced Principal CHARLES A. EDWARDS of the University College, Swansea, Wales. The title of his address was *Science, education and industry: whither drifting?*

The 264th meeting was held on Thursday, March 21, 1935, with about 125 persons present. Past-president L. B. TUCKERMAN introduced Professor RAYMOND PEARL, of Johns Hopkins University, who spoke upon *Biology and human trends.*

The 265th meeting was held Thursday, April 18, 1935, with 42 persons present. Vice-president J. F. COUCH introduced RUSSELL S. MCBRIDE, who spoke upon *The service and failures of chemistry in the advancement of civilization.*

The 266th meeting was held jointly with the Medical Society of the District of Columbia on November 21, 1935, with about 100 persons present. President MCCOY introduced Col. P. M. ASHBURN, M.D., who spoke upon *The medical history of the conquest of the Americas in the 16th and 17th centuries.*

The 267th meeting was held jointly with the Philosophical Society on Thursday, December 19, 1935, with 70 persons present. President MCCOY introduced Dr. SANFORD V. LARKEY, Librarian of the Welch Memorial Library of Johns Hopkins University, who spoke upon *The role of scientists in the Elizabethan Government.*

The 268th meeting was held on January 16, 1936, with about 110 persons present. Vice-president O. H. GISH introduced the retiring president, Dr. GEORGE W. MCCOY, who spoke upon the *Comings and goings of epidemics.* At the end of the meeting, the vice-president declared a recess preceding the 38th Annual Meeting.

The report of the Treasurer, H. G. AVERS, was read by Mr. HOWARD S. RAPPLEYE:

CASH RECEIPTS AND DISBURSEMENTS

Receipts				
From Back Dues		$ 265.00		
From Dues for 1935		2,390.00		
From Dues for 1936		30.00		
From Subscriptions for 1935		743.60		
From Subscriptions for 1936		281.40		
From Sales of Journals		102.87		
From Payments for Reprints		238.83		
From Sales of 1932 Directory		1.80		
From Sales of 1935 Directory		41.70		
From Interest on Deposits		25.27		
From Interest on Investments		1,459.70		
Total receipts			$5,580.17	
Cash Balance January 1, 1935			2,526.54	
To be accounted for				$8,106.71
Disbursements				
For Secretary's Office		$ 290.35		
For Treasurer's Office 1934		2.25		
For Treasurer's Office 1935		226.88		
For Journal Office, 1934		46.94		
For Journal Office, 1935		324.72		
For Journal Printing, 1934		384.65		
For Journal Printing, 1935		2,753.24		
For Reprints		495.83		
For Illustrations		360.46		
For Meetings Committee, 1934		20.00		
For Meetings Committee, 1935		201.50		
For Directory		629.37		
Bank Debit Memos, as follows:				
Dues	$0.35			
Subscriptions	.11			
Sales of Journals	.50			
Reprints	.35			
Int. on Investments	.44	1.75		
Total Disbursements			$5,737.94	
Cash Balance December 31, 1935			2,368.77	
Total				$8,106.71

Note: Of the above expenditures, the amount of $453.84 was paid covering bills chargeable to 1934.

He listed the investments of the Academy as totalling $21,096.37.

The Auditing Committee, HOWARD S. RAPPLEYE, W. H. BRADLEY and JAMES F. COUCH, reported:

"The Treasurer's records of receipts and expenditures as shown in his account books and included in his report have been examined and found correct. All vouchers have been examined and found to be correct and properly approved. The balance sheets submitted by the bank and the securities listed in the Treasurer's report have been examined. The statement of the assets of the Academy was found correct. The records of the Treasurer's Office have been carefully and systematically kept, thus greatly facilitating the work of the Auditing Committee."

The Board of Editors, JOHN A. STEVENSON, F. G. BRICKWEDDE and ROLAND W. BROWN, submitted the following report covering the publication of Volume 25 of the Journal for the year 1935:

"Volume 25 consisted of 588 pages, including an eight-page index. This compares with 576 pages in 1934, 588 in 1933, 572 in 1932, and 552 in 1931. It contained 75 original papers as contrasted with 78 in 1934, 77 in 1933, and 79 in 1932. Thirty-seven papers were by members of the Academy, and 38 were communicated of which latter number several were by authors who became members of the Academy after the date of receipt of their papers. Original papers were illustrated by 73 line cuts and 10 half-tones. Excess cuts illustrating several papers were paid for by the respective authors. Space in the volume was distributed among the different sciences, as follows:

	Pages
8 papers on Physics, including Geophysics and Seismology	106.8
4 papers on Chemistry	15.20
2 papers on Crystallography	14.20
3 papers on Pharmacology	11.6
9 papers on Geology, including stratigraphy and hydrology	40.55
10 papers on Paleontology, including paleobotany	34.15
2 papers on general Biology	24.7
17 papers on Botany	87.20
10 papers on Zoology	83.40
9 papers on Entomology, Ornithology and Conchology	35.20
1 paper on Psychology	14.35

Proceedings of the Academy and affiliated societies occupied 54.7 pages, as follows:

The Academy	2.65
Anthropological Society	1.35
Botanical Society	11.10
Geological Society	24.45
Philosophical Society	15.15

Scientific notes and news, and obituaries occupied the remaining 47 pages.

As in 1934, scientific notes and news as supplied by Science Service were used to the extent of approximately four pages per number, space given to original papers permitting. Acting upon the recommendation of the Board of Editors, the use of news notes was dispensed with by the Board of Managers at the end of the calendar year. The number of papers in the biological field presented for publication was approximately the same as in the preceding year so that further effort has been made to obtain papers in the field of the physical sciences. The JOURNAL is, relatively speaking, up-to-date with manuscripts submitted to it.

The cost of printing, wrapping, mailing and postage was $4.59 per printed page; illustrations 70 cents per page; alterations 10 cents per page; and reprints 84 cents per page. Of this latter amount approximately one-half was paid for by the respective authors. The cost of the News Service was $300. Exclusive of the cost of the News Service and reprints, the total cost per page for printing the Journal was approximately $5.20, a slight reduction over last year's cost."

The Board of Tellers, GEORGE A. GREENBANK, W. H. BRADLEY and L. V. JUDSON, reported the election of the following officers: President, O. E. MEINZER; Non-resident Vice Presidents, PAUL D. FOOTE, Pittsburgh, Pennsylvania, and P. C. STANDLEY, Chicago, Illinois; Corresponding Secretary, NATHAN R. SMITH; Recording Secretary, CHARLES THOM; Treasurer, H. G. AVERS; Board of Managers, PAUL E. HOWE and H. L. DRYDEN.

The Corresponding Secretary read the list of nominations for vice-president submitted by the affiliated societies as follows:

Philosophical Society of Washington, FRANCIS B. SILSBEE
Anthropological Society of Washington, F. H. H. ROBERTS
Biological Society of Washington, CHAS. E. CHAMBLISS
Washington Section, American Chemical Society, JAMES H. HIBBEN
Entomological Society of Washington, A. H. CLARK
National Geographic Society, FREDERICK V. COVILLE
Geological Society of Washington, W. T. SCHALLER
Medical Society of the District of Columbia, H. C. MACATEE
Columbia Historical Society, ALLEN C. CLARK
Botanical Society of Washington, CHARLES DRECHSLER
Archaeological Society of Washington, ALES HRDLICKA
Washington Section, Society of American Foresters, S. B. DETWILER
Washington Society of Engineers, PAUL C. WHITNEY
Washington Section, American Institute of Electrical Engineers, H. G. DORSEY
Washington Section, American Society of Mechanical Engineers, H. N. EATON
Helminthological Society of Washington, EMMETT W. PRICE
Washington Branch, Society of American Bacteriologists, H. W. SCHOENING
Washington Post, Society of American Military Engineers, C. H. BIRDSEYE
Washington Section, Institute of Radio Engineers, LOUIS COHEN

By vote of the Academy, the Recording Secretary was instructed to cast one vote for the list as read and the vice-presidents were declared elected.

President MCCOY appointed Past Presidents W. J. HUMPHREYS and L. B. TUCKERMAN to escort President-elect MEINZER to the chair. President MEINZER took over the gavel and addressed the Academy briefly.

Adjournment followed at 9:45.

CHARLES THOM, *Recording Secretary*